THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
Foreign Trade Organisation	737
Rubber	738
Electricity Supply Works and Coal Supplies	738
New Lamps	739
The Large Turbine and Supply Problems (*illus.*)	739
The British Standardisation Rules for Electrical Machinery	741
A New High-Efficiency Incandescent Lamp, by E. A. Gimingham and S. R. Mullard (*illus.*)	743
Notes from Canada	745
The Park Royal Engineering Works, Ltd. (*illus.*)	745
New Electrical Devices, Fittings and Plant (*illus.*)	746
Electrical Accidents in 1914	747
Legal	748
Making and Using Thermocouples, by F. G. Coburn	748
Diesel Engine Users' Association	749
Business Notes	750
Notes	754
City Notes	758
Stocks and Shares	759
Share List of Electrical Companies	760
Market Quotations	760
Electrical Accidents in Mines (*continued*)	761
Our Trading Opportunities throughout the World (*continued*)	762
Some Difficulties of Design of High-Speed Generators, by Prof. A. B. Field, (*illus.*) (*continued*)	764
Correspondence—	
A Contractor's Complaint	766
The A.E.G. Meeting	767
The Institution and Alien Enemy Members	767
Swiss or German?	767
War Items	767
New Patents Applied for, 1915	768
Abstracts of Published Specifications	768
Contractors' Column — Advertisement page xx	

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FOREIGN TRADE ORGANISATION.

OUR readers are already familiar with the main methods by which German industry has been able to make its abnormally rapid advance. The development of foreign trade has been one of the most important of these methods. Only since the outbreak of war has it become obvious how closely cause and effect were interwoven where Germany's foreign trade was concerned, how disinterested Teutons suggested developments and drew up plans, again apparently disinterestedly, so that only German equipment met the specification, how the necessary capital support was always forthcoming at the psychological moment, and how ultimately the whole project was controlled from Germany for the main or entire benefit of Germans.

The sinister feature of this policy and the only one to which objection could be taken was the secrecy and deceit with which the German control was obtained. Had the deal been fair and above board, it might have succeeded in most cases to practically the same degree, and no one could have raised any objection, for there is nothing wrong in a wealthy syndicate offering money for development schemes on terms favourable to firms associated with it, so long as the person accepting these terms knows their nature. If the negotiation amounts simply to advancing capital or taking up concessions with no definite "tying" to certain markets for the purchase of subsequent supplies, it is still less open to objection; but tying itself cannot be objected to, if it is a stated or obvious consequence of the original negotiation. Getting into fresh markets by this means is simply good business, and our business men must decide whether it is a method for us to adopt more extensively in future than in the past. With the conclusion of nominal peace we shall, so far as we are able to foresee, merely exchange one form of war for another. Our present enemies in the field may then be formidable enemies in trade. Their capital will be gone—if, indeed, it has not already vanished despite the "isolation" of the country—but the organisation and discipline of the nation will remain, and its captains will make herculean efforts to recover the lost position.

As for the neutral countries of the world, they will be very keen competitors. They have become possessed of no small portion of the Allies' wealth—directly by supplying costly war materials for which we have paid and (from the purely commercial standpoint) blown into thin air, and indirectly by taking advantage of markets from which we have temporarily withdrawn capital and energy. By both these means the neutral nations, chief amongst them the States, have acquired an immense advantage which they are entitled to use, and which they certainly will use to the best of their organisation and ability.

The National City Bank of New York announces the formation of a £10,000,000 company to develop foreign trade with the States, by promoting foreign loans and investment schemes, so as to create a market for American capital and manufacture. That is the sort of thing for

which we must prepare. We cannot complain at the arrangement nor would it be of any use to do so. Such measures are legitimate, but for our own well-being they must be met by equally energetic measures. Cannot we have a big Empire loan or investment scheme for the same purpose? The financing of manufacturing industries has long been one of our weak places.

The new venture is probably the most ambitious yet made to further the commerce of the States, and it is admittedly a direct outcome of benefits derived from the war. The fields in which it is proposed to operate are South America and Russia—*particularly the latter*. We are not alone in realising the immense potentialities of the Russian Empire, and in recognising the fact that outside capital will be required for many years to develop those potentialities, whilst the chief benefits in supplying machinery and equipment will go to that country which makes the development possible. In the electrical field alone the requirements of Russia for power stations, for electric traction, for industrial power and domestic supply, will be immense in the immediate future, and the prospects are equally good in other engineering and in general industrial fields. Clearly the matter is a national one—if not for Government support, then for organised private support on a national scale. Henceforth we can hardly do without national support for the enterprise of our individual manufacturers; that powerful weapon has long been used by our chief rivals.

Rubber.

Rubber prices have kept up very well, though there has been a certain degree of fluctuation, which resulted in a rather uncertain tone amongst consumers, with a falling-off in the amount of new business being placed. The firmness of the market at times induced actual users of material to cover themselves ahead as far as possible, but, as the purchasing abated in this connection, so there were occasional spells when the tendency became reactionary. The activity of hostile submarines in the Mediterranean has had a sharp effect in raising prices, now that the Huns can score a success and have managed to put down a boat with a large consignment of rubber on board. After all, there is always the Cape route home if the worst comes to the worst, but, meantime, there is no doubt that proper steps are being taken to rid the Mediterranean of these Hunnish pirates and baby-killers. On the advancing prices, America bought liberally, for United States consumers are treated by their Press to a diet of falsehood, and apparently to very little truth; the United States Press has for weeks been announcing as facts things unknown, and not believed here to be the case. However, the fouling of our own nest by our censors seems to be part of the game, for any silly falsehood is apparently permitted to go over the cables so long as it reflects unfavourably upon the Allies, while any statement in our favour is withheld. So much for American news and the Censorship.

The pack of falsehoods about the Suez Canal, sent to New York by permission of the Censorship, resulted in an advance of 9 cents per lb. in the price of Ceylon plantation rubber to 68 or 69 cents per lb., an increase of 15 per cent. This was described as "an unfortunate interruption to the serenity which has surrounded the big rubber users of the United States ever since they made their peace with the British Government about 12 months ago, and agreed to keep crude rubber from falling into German hands." There is a fair-sized stock of crude rubber in the United States to-day, but if there were an interruption of Far Eastern shipments for much beyond a month, some of the large consumers might find themselves in difficulties. America, if hindered in the East would, of course, draw heavily on Para rubber from Brazil. As regards the Dutch position, it is now intimated by the Dutch Overseas Trust that that body will accept no further consignments of rubber. This is a distinct point gained to the Allies, for there is not the least doubt that Germany has been receiving a lot of rubber by way of neutrals.

The following figures show the Straits Settlement exports:—

	1913.	1914.	1915.
January	784	1,181	2,576 tons.
February	743	1,703	2,741 ,,
March	898	1,285	2,477 ,,
April	762	1,548	1,978 ,,
May	814	1,309	3,588 ,,
June	812	1,480	2,249 ,,
July	1,120	1,584	2,324 ,,
August...	1,315	1,325	2,295 ,,
September	1,057	1,602	4,725 ,,
October	1,144	2,006	2,641 ,,
Total	9,449	15,023	27,594 ,,

These figures include transhipments of rubber from various places in the neighbourhood of the Straits Settlements, such as Borneo, Java, Sumatra, and the non-Federated Malay States, as well as rubber actually exported from the Colony, but they do not include rubber exports from the Federated Malay States.

Electricity Supply Works and Coal Supplies.

The comparative scarcity and high prices of coal and the comparative dearth of labour, in the face of the large demands for both on the part of industrial establishments which are engaged on the production of munitions of war, are having a far from favourable effect in certain belligerent countries, especially in those whose national output of coal is inadequate to meet their own requirements, and the resources of the gas and electricity works which supply light and power to these establishments are being strained to cope with the situation. In France the first call on the domestic output of coal is made by the military authorities, the railways, the iron and steel works, the manufacturers of war material, and the gas and electricity works, and a similar observation may be said to apply also to every country at war. The difficult state of affairs in Italy, whose out-turn of coal is totally insignificant, has induced the Association of Working Electrical Undertakings (Associazione Esercenti Imprese Elettriche) to hold a meeting at Milan, under the presidency of Senator Esterle, in the presence of the representatives of most of the electricity works, including the Edison Co. the Conti Co., the Idroelettrica Ligure, the Adriatica Co., the municipal councils of Milan and Turin, &c. The object of the conference was not so much to discuss the question of coal supply, as water power is used to a large extent in the country, as to afford an opportunity for an interchange of ideas as to how the relations between suppliers and consumers of electrical energy should be regulated in an equitable manner under existing circumstances. It was eventually agreed that producers should arrange local meetings with the principal customers in every important district for the purpose of coming to special agreements in their mutual interests, particularly in regard to the supreme requirements of the industries at the present time. As will be remembered, a State tax has been in operation for some years, on the consumption of electricity—at least for heating and lighting purposes. The Association has sought to secure the abolition of the tax on the use of energy for heating, but the Ministry of Finance points out that the tax represents the law of the country, and cannot be modified without the previous approval of Parliament. However, to meet the case, the Minister of Finance proposes to ask the Ministerial Council to issue a special decree for an experimental period of six months, exempting consumption for heating from the tax, whilst on their part producers wil have to keep special accounts of the energy used for this service as compared with the corresponding period a year ago. A statement to this effect was made by the President to the Conference, which, naturally, did not entertain any great expectations of a large extension of the application of electricity to heating under present conditions. In Italy electric heating has to be considered chiefly as providing a substitute for coal at the

moment, but the reserve manifested by the Conference as to the possibilities of much development in the near future was more than shared a fortnight previously by an Italian engineer who contended, rightly or wrongly, that at the present high price of coal in Italy, it would be cheaper to use the latter than electrical energy for heating, even if the tax were entirely discontinued. Imported coal for domestic use is reaching £4 per ton in France, owing chiefly to the high freight rates and general labour conditions, but the cost is still higher in Italy, being £4 1s. 7d. per ton on rail at Genoa, and £4 12s. per ton at Milan. With these facts before us, it is difficult to believe the recent assertion made by the chairman of the Zurich Bank for Electrical Undertakings who, speaking of the dearness of coal experienced by electricity works in Spain, Portugal, Italy, and Russia, stated that the price paid by the Italian Officine Genovesi was 30 per cent. more than a year ago. If this rate were correct the company would be able to congratulate itself upon having secured coal at a comparatively low price under existing circumstances, especially as industrial coal cannot be put on rail at Italian ports at a price lower than that of coal for domestic consumption.

New Lamps.

That the possibilities of electric lighting have by no means attained their limit with the tungsten filament is well exemplified by the remarkable invention which is described elsewhere in this issue—an enclosed arc lamp, in which the arc is struck between tungsten electrodes in an atmosphere of nitrogen. The description was contained in a communication to the Institution of Electrical Engineers by Messrs. E. A. Gimingham and S. R. Mullard, and the whole matter is of exceptional interest, for several reasons.

In the first place, this invention was not arrived at by a happy thought, a fortuitous train of circumstances, or a stroke of genius; it is the direct result of a research instituted by the Edison & Swan United Electric Light Co., Ltd., at their works at Ponders End, for the express purpose of developing precisely such an invention. We most cordially welcome this demonstration of the fact that some of our manufacturers are awake to the supreme importance of scientific research conducted on systematic lines with set purpose, and recognise the necessity of allocating to such a research a competent staff and adequate equipment. We trust that the Edison & Swan Co. will reap the fullest reward for this admirable example of successful enterprise.

In the second place, we see in this lamp the same materials as are used in the half-watt incandescent lamp, but used in a fundamentally different way, and we are irresistibly reminded of the clever paper on "Invention" that was read by Mr. Charles Turnbull before the Newcastle Local Section of the I.E.E. some years ago, in which the author pointed out how one invention might lead to another by a suitable metamorphosis.

Thirdly, the method of striking the arc in this lamp, by ionising the gas in the vicinity of the electrodes, involves once more the principle of the thermionic current which has been so ably applied by our American friends in the development of the kenotron rectifier and the pliotron amplifier—building on the foundation laid by Mr. T. A. Edison, Dr. J. A. Fleming, and Mr. O. W. Richardson—in the great research laboratory that we have held up to our readers as a splendid example.

The results obtained already are excellent, and will exert a material influence on many applications of the electric light; but we doubt not that further progress will be made. A research is actually in progress in the United States in the direction of utilising an arc between unconsumed tungsten electrodes, in an atmosphere containing vaporised salts, but in this case the arc is several inches in length. It is clear that this new field of investigation possesses vast possibilities.

THE LARGE TURBINE AND SUPPLY PROBLEMS.

During the past 20 years a radical change has occurred in our ideas as to central station design and practice, due in great part to the rapidly changing conditions of electricity supply. We have been passing through the "retail" stage, but are now rapidly approaching the "wholesale" stage, when quantity production of electricity will become an essential factor to success. Some measure of the changed conditions can be gathered from the increase in consumers and output during the period mentioned, in individual centres where conditions are favourable, as, for instance, in a Scottish city, where the consumers have multiplied by 55 and the output by 100, although no traction supply is included; or a Lancashire city, where with 20 times as many consumers as in '95, the output is 125 times as great, including traction supply, and 85 times, excluding the latter. The ratios for any town will vary according to the industrial conditions obtaining, and are, no doubt, increased in the cases mentioned, by the absorption of adjoining supply areas during the period referred to. The position to-day cannot be judged without some idea as to the rate of increase in output, which with the growing appreciation of, more particularly, electric power applications, has had a marked upward tendency in recent years, where favourable conditions exist for development.

There is another feature which influences rate of progress and cannot be ignored in this country. Every industrial emergency resulting in interference with fuel or labour has the effect of increasing the rate of output of electricity, which is equivalent to an admission that electricity is the cheapest power and most convenient labour-saving agency on the market. The position is then that just as the lower-pressure direct-current station with direct retail distribution has given place to the medium-pressure alternating station with a combined distribution, partly bulk to substations and partly direct to the consumer, so will this phase of development be superseded by the bulk high-pressure generating station, designed to utilise to the full our existing means of producing cheap electricity, which will, in fact, be supplied in bulk to the distribution area.

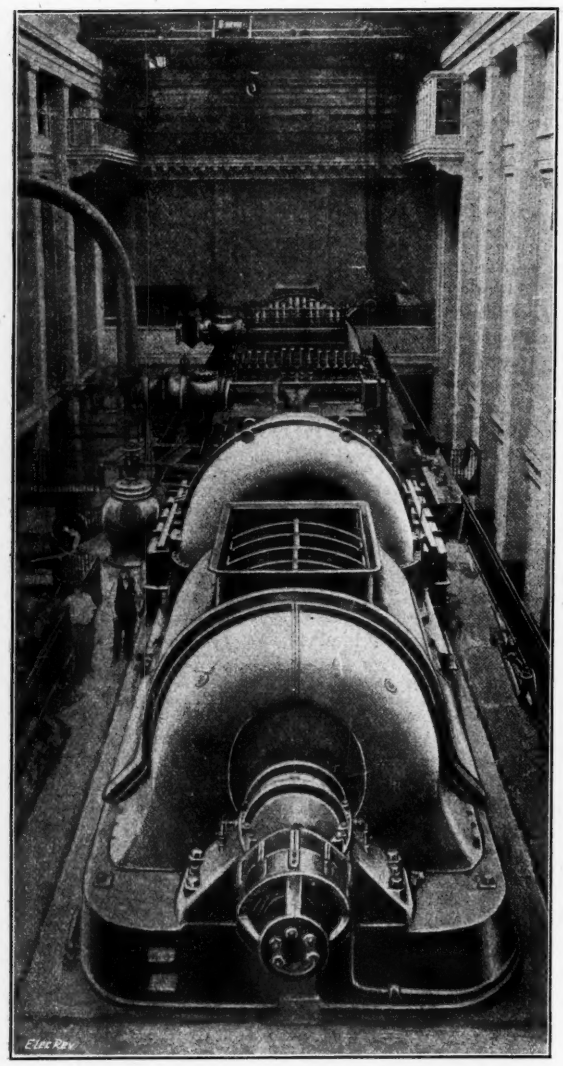
A scheme of this kind would necessarily involve the use of only the largest turbine and boiler units available under the circumstances, because they would, relatively to the output, be the cheapest to purchase and operate, and in order to realise the full benefit of its capacity, it would probably require us to fit the supply area to the station, rather than as at present fit the station to the parochial needs of the area *at the moment*.

There is nothing novel in this idea, but, unfortunately, it is not appreciated by those who might benefit by it; neither does it appear to be appreciated that every pound spent in perpetuating any but the largest type of generating plant, where that can be utilised, is actually an obstacle to the production of electricity at minimum cost, and an additional burden on the consumer on whom obviously the excess cost must fall. In this connection the municipal boundary line has much to answer for; as a barrier to co-operation it probably has had no equal, and so far as municipal co-operation in electricity supply is concerned, it has more frequently proved insurmountable.

Curiously enough, our electricity suppliers, municipal and otherwise, in their dealings with consumers, are the most enthusiastic exponents of the principle of concentrating power production and of entrusting to experts the generation of power, although they show no inclination amongst themselves to practice what they preach to their consumers. Not only so, but extensions to individual plants are too frequently stopgaps, introduced solely to fill the pressing requirements of the next 12 months. In a time of stress like the present, and such as will probably exist during the next few years, the question which naturally occurs to us is whether we can afford to prolong our present methods of electricity supply—whether circumstances, such as the need for national economy in expenditure after the war and the paramount necessity of introducing into our industrial life economy in time and labour, in which electrical methods play such an important part, will not compel us in the near

future to sweep away all artificial barriers to economic progress and abandon the narrow-minded methods of the past.

It is admitted that the miniature supply areas of this country do not individually in their present state of electrical development give scope for the use of really large turbines, but in the matter of the generating station there appears to be no reason why joint ownership should not be adopted in many cases, and, indeed, favoured by that Government department which, as regards municipal expenditure, is supposed to safeguard the poor ratepayer's pockets. Such a course would undoubtedly hurry up our electrical development at a time when it is most needed.



30,000-KW. AND 35,000-KW. SETS IN THE PHILADELPHIA ELECTRIC CO.'S STATION.

It may be of some interest in this connection to draw attention to the progress of the big unit station in America.

The bulk supply station is, of course, no new thing in this country—on paper, at least—but the only really big unit plant which we can count on as likly to materialise within the next few years is the Barton station of the Manchester Corporation, which authority, it may be noted, supplies in several districts adjoining the city boundary. This station is planned to utilise 15,000 KW. and 25,000 KW. turbine units, but before the latter sized units are installed it is quite possible that the 50,000-KW. turbine, to which serious consideration is being given in the States, will have become a reality.

At the present time, New York City boasts a station laid out to accommodate eight 30,000-KW. turbine sets of a hybrid pattern, each machine consisting of two steam-electrical units, for traction purposes, while turbines of similar output are used in Chicago and at Philadelphia in the new Christian Street station, where, in addition to a 30,000-KW. unit, a 35,000-KW. turbine plant, the largest so far installed, has recently been put to work. Some details of this machine appeared recently in the *Electrical World*, which mentioned that it consisted of a 13-stage Curtis turbine operating on steam at 215-lb. pressure, 150° F. superheat, and exhausting into a 50,000 sq. ft. central flow surface condenser. The generator supplies a three-phase, 60-cycle current at 13,200 volts, and is coupled direct to a 150-KW., 250-volt exciter mounted on the shaft. The whole machine measures 63 ft. 2 in. in length, is 21 ft. 7 in. wide, and 15 ft. 10 in. high, the speed being 1,200 R.P.M., while as to steam consumption, 11·8 lb. per KW.-hour at the most efficient load, 25,000 KW., and 12·5 lb., at the full output of 35,000 KW., are guaranteed. The steam-raising plant of the new station will consist of 20 60,000-lb. boilers.

We illustrate another 30,000-KW. Curtis turbine set which has recently been installed in the Waterside generating station of the New York Edison Co., bringing the capacity of plant installed up to 500,000 H.P. This machine consists of a 10-stage high-pressure steam turbine and a two-stage double flow low-pressure turbine coupled to a generator on the same shaft, running at 1,500 R.P.M. Steam is supplied at a pressure of 185 lb. per sq. in. and exhausted into a 50,000 sq. ft. surface condenser.

The Westinghouse Co. is supplying the Commonwealth Edison Co., of Chicago, with a single shaft turbine unit of 35,300 KW. This will comprise a tandem-compound Parsons type turbine coupled to a three-phase 60-cycle 12,000-volt generator rated at 35,300 KW. at 85 per cent. power factor, with a direct-coupled exciter. The turbine will run at 1,200 R.P.M. on steam at 220 lb. pressure with 200° superheat, and will exhaust into a 29-in. vacuum. This unit will measure 75 ft. long by 18 ft. 6 in. wide and 21 ft. high, over all.

Single turbine units of 20,000 KW. are also used in the New York, Chicago, Cleveland and Detroit Central Stations.

At the New Conners Creek station of the Detroit Edison Co. the first 50,000 KW. section of which is now in operation, a 150,000-K.V.A. plant is to be put down in six 25,000-K.V.A. units, and will be supplied with steam from boilers of exceptional size, each of 23,654 sq. ft. heating surface. Only two such boilers will be used for each turbine unit and no provision for spare plant, as usually understood, is made, although arrangements have been made for three boilers to supply two turbines, and the boilers can be safely operated at more than 170 per cent. of their ordinary steaming rates. The steam pressure is 225 lb. per sq. in., and 200° F. of superheat at 200 per cent. of rating is provided for. What are usually considered unavoidable heat losses are minimised by passing the air from the engine room through a pipe gallery, where it passes over the steam pipes, to the fan equipment of the boilers.

The *Electrical World*, referring to the discussion on economics of power-station design at the recent San Francisco Engineering Congress, mentioned that Mr. H. H. Barnes, jun., intimated that boiler pressures much higher than 250 lb. would be found feasible and economical; a pressure as high as 1,000 lb. was suggested as a possibility for turbo-generators of 40,000 KW. to 50,000 KW.

The opinion of Mr. C. W. Clarke is given that 400 lb. per sq. in. boiler pressures are feasible, and that high-steam pressure rather than very high superheat is to be preferred and would mark a decided gain in turbine efficiency. Steam pressures of 500 to 600 lb. per sq. in. could be looked for in due course, and would represent a gain of about 9 per cent. in turbine efficiency.

Mr. P. M. Lincoln considered that the capacity of the future unit would be fixed by the demand for such units rather than by any inability to produce them, and Prof. Miller remarked that a noticeable saving in labour would occur with the largest size turbines, and that as their efficiency could be but slightly improved with existing steam pressures and superheats, higher steam pressures would be introduced, marking a new departure in power plant practice and raising the efficiency on the Rankine cycle considerably above the present maximum of about 73 per cent.

Mr. H. G. Stott said that the 30,000-KW. steam turbine had surpassed the gas engine in thermal efficiency, reaching

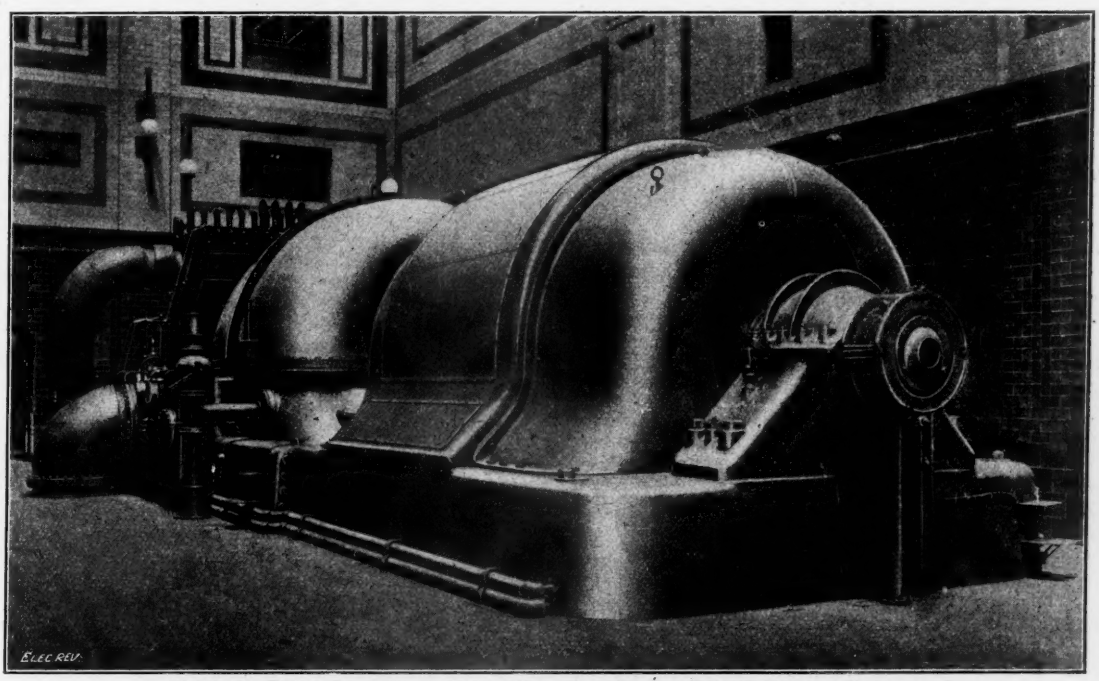
26 to 28 per cent., which was only surpassed by the Diesel oil engine; the floor space occupied by the horizontal steam-turbine generator was only $\frac{1}{10}$ to $\frac{1}{15}$ sq. ft. per KW. It may be added that opinions on the operation of such large turbine units do not appear to anticipate any difficulties.

As regards increased boiler pressures, the Public Service Co. of Northern Illinois is installing a 10,000-KW. turbine unit which will run on steam at 300 lb. pressure and 200° superheat. The Babcock boilers supplying steam to this machine are constructed for a pressure of 350 lb. per sq. in.

It is interesting to note that in this country so far as the feeling has been indicated at all, it appears to point in the direction of very high superheat for future turbine practice—as, for instance, in the Ferranti steam gas tubine. It is also almost certain that the development of large unit bulk supply generating plants would be accompanied by sufficiently favourable load conditions as to render the adoption of gas firing and by-product recovery an attractive proposition, the increasing price of coal being a probable contributing factor.

The fact that these ultra-developments are problematical at the present time does not detract from the economic necessity of adopting the most advanced methods of electricity supply available.

We must get away from the "municipal area" idea, remembering that the intensive development of one town far ahead of its neighbours, will result in far less advantage to the inhabitants, than the general development of the whole country; the former would have an infinitesimal effect on the price of apparatus as compared with enormous sales resulting from the latter.



30,000-KW. Turbo-Generator at the New York Edison Co's Waterside Station.

THE BRITISH STANDARDISATION RULES FOR ELECTRICAL MACHINERY.

We have already briefly announced the issue of Report No. 72 of the Engineering Standards Committee, which deals with "Electrical Machinery (excluding motors for traction purposes)," and supersedes the Interim Report of 1904. The new Rules are extremely interesting, and undoubtedly constitute the fruits of a vast amount of work, not only on the part of the very representative sub-committee which drew them up, but also of the International Electrotechnical Commission. We may remind our readers in this connection that the Sectional Electrical Committee of the E.S.C. is also the British National Committee of the I.E.C. Perhaps the most important section of the report is that which deals with the limiting temperatures for insulating materials, a subject which has given rise to much controversy in the deliberations of the I.E.C.; the crucial point was the temperature to be adopted as a standard for the cooling air, it being held that the *maximum* temperature to which the cooling air might be expected to rise should be taken. Obviously, unless this were done, it would be impossible to specify the permissible temperature rise in such a way that the maximum limit permissible for the total temperature should never be exceeded. It was abundantly proved that the cooling air even in temperate climates often attained a temperature of 40° C., and this was the value advocated by the British and American Committees, but the Germans stood out for a lower value, being clearly averse to lowering the rating of their machines to the value assigned to it by other nations. The importance of universal agreement on this point was very great from a commercial point of view, as any nation which rated its machines by a lower standard would of course secure an unfair advantage over its rivals, to the prejudice of the purchaser.

It is stated that the rules have been based on the limiting temperatures for insulating materials agreed to at the last Plenary Meeting of the I.E.C. held in Berlin in 1913, and that considerable advantage has accrued from the co-operation of the American Standards Committee in this work, a conference in London in March last being attended by Mr. H. M. Hobart and Mr. C. E. Skinner as the official representatives of the American Institute of Electrical Engineers. The Canadian National Committee of the I.E.C. was also officially represented at the conference.

The Interim Report of 1904 cannot be said to have commanded the approval and acceptance of the electrical industry in this country, and with a view to arriving at a working arrangement, pending the issue of the present report, the British Electrical and Allied Manufacturers' Association drew up a provisional code of standards, the first part of which was published in our issue of May 23rd, 1913; a supplement appeared in our issue of May 21st, 1915.

In issuing the latter, the B.E.A.M.A. stated that, owing to the approaching completion of the Engineering Standards Committee's Report, the original rules were reissued without alteration—otherwise certain changes would have been made; this statement, and the fact that the B.E.A.M.A. is represented on the sub-committee responsible for the new rules, lead us to infer that the Association will adopt the latter, at any rate so far as they cover common ground—for the Association code also deals with matters which are not touched upon in the present report.

The following is a brief summary of the more important features of the rules; the latter, of course, cannot be re-published in our pages in full. In a later issue we shall compare some of the provisions of the new code with those of its forerunners.

The first section is devoted to definitions, and is followed by standards of frequency, phase, and wave form for A.C. machines; these are commendably few, and call for a 50-cycle, three-phase, sine-wave standard generator. It is interesting to note that two-phase machines are explicitly banned. We then meet with definitions of eight types of generators and motors—open, protected, semi-enclosed, totally-enclosed, pipe-ventilated, forced-draught, drip-proof, and flame-proof—this section being, in fact, a glossary.

The standard for continuous rating is defined as the output at which a machine can work for an unlimited period and comply with these rules. This rating includes the equivalent of the overload that is commonly specified. For intermittent service two standards for short-time rating are provided—one hour, and half hour. Variable-speed machines are to have a definite rating for each of the limiting speeds. The maximum cooling air temperature to which the rules apply is 40° C., and this has been used in fixing the limits of temperature that may be attained, which are all included between 90° and 115° C.; the limits depend upon the materials employed for insulating the windings, being for rotating armatures with commutators 90° C. when the insulation is effected with impregnated cotton, paper and similar materials, and enamelled wire, and 110° when asbestos, mica, etc., is employed. Field magnet coils, A.C. windings in slots, and transformer windings, are allowed an extra five degrees. Commutators, slip-rings, and transformer oil are limited to 90° C. For cotton, etc., when neither impregnated nor immersed in oil, the temperature limit is placed 10° C. lower.

The duration of the temperature test run is of some importance, especially in the case of large machines, and the new standards of procedure are here very helpful; they permit the time required to attain the final temperature to be shortened by running the machine on overload at first, the load being afterwards reduced to rated conditions and kept constant long enough to make sure that the temperature of the machine would not exceed the standard if the test were prolonged until a steady final temperature had been reached.

The temperature recorded is to be the highest observable; when it is found that the temperature of a part goes on increasing after stopping the machine, the highest value is to be taken, and if the temperature on the other hand is falling, corrections are to be applied. Provision is made for the temperature test of a machine for intermittent service to commence when the highest of the observable temperatures of the windings is the same as that of the cooling air; this is obviously necessary, but the utility of a similar proviso in the case of a machine for continuous service is not easily seen, as it is expressly provided that the latter may be run at an excess load if desired, to reduce the period of test. The *highest* observable temperature is to be taken, no matter whether it be obtained by resistance measurement or by the use of a thermometer; no doubt is left, however, as to which method is regarded by the Committee as the more reliable, as the resistance method is definitely prescribed for all field coils except those of very low resistance (series windings), and for other windings when practicable; in certain cases the thermometer may be used alone, although the resistance method is practicable, but in such cases the temperature limit is placed 5° C. lower. A notable innovation is the employment of temperature detectors—thermocouples or resistance thermometers—which are to be embedded in the windings of machines over 3,000 KW. and 3,300 volts, if specified in the first instance. When these detectors are embedded between two coils in one slot, an extra allowance of 5° C. over the standard limits is made, whereas if the detectors are between the insulated coil and the iron core, the par values must be taken for the limits. If, however, the rated pressure of the machine exceeds 5,000 volts, the permissible limits are reduced by 1° C. for each thousand over five, evidently to allow for the increased thickness of the insulating material. The temperature coefficient of the change of resistance of copper is neatly defined by the formula $1/(234.5+t_0)$ where t_0 is the initial Cent. temperature of the winding; the sequence of the figures makes them easy to remember.

Entirely new mechanical tests are prescribed; any machine must be capable of withstanding for 15 seconds a load in amperes 100 per cent. in excess of its standard rating, at rated voltage—for 30 seconds in the case of a motor for intermittent service—and an induction motor must not be stalled by a torque less than 75 per cent. above normal rating. Motors with short-time rating, other than the squirrel-cage induction type, must be able to exert a starting torque 100 per cent. in excess of the normal full load.

Under the heading "Commutation Tests" it is specified that a D.C. machine with fixed brushes shall work "practically sparklessly" from no load to the rated load; we appreciate the difficulty of defining the permissible degree of sparking, but it will be seen that the difficulty has not been overcome, and compliance with the rule remains a matter of opinion.

High-pressure tests are to be applied for one minute between copper and iron, and range from twice rated pressure plus 500 volts (R.M.S.) for very small machines to twice rated pressure plus 5,000 volts for those of the largest size and pressures over 5,000 volts. Rotating field windings, however, are subjected to a test pressure ten times the rated pressure. Current and pressure transformers are to be tested at the rather curious value of $2\frac{1}{4}$ times the rated pressure + 2,000 volts. Various other pressure tests are specified for particular cases, and the desirable insulation resistance in megohms is indicated by the formula

$$\frac{\text{Rated pressure in volts}}{1{,}000 + \text{Rated output in K.V.A.}}$$

with a minimum of one megohm; but strict compliance with the formula is not insisted on, and it is pointed out that insulation resistance higher than the value indicated should not be asked for, as the insulating material may be damaged by the severe baking to which it may have to be subjected. The test is made with a pressure of about 500 volts, continuous.

Information to be given on the rating plate is specified in great detail, there being six cases to provide for; an interesting innovation is the requirement that on transformers the rating plate shall carry a vector diagram showing the phase relations in a three-phase transformer, and a connection diagram showing the relation of the various terminals to the windings. This is a very practical and useful stipulation, and will prevent many mishaps. The terminal marking is a necessary complement to the diagrams, and is intended to indicate at once the (relative) pressure and polarity of the primary and secondary windings.

The last section deals fully with the information to be given with the inquiry and when ordering machines.

The list of standard pressures for electrical machinery, which formed a prominent feature of the report of 1904, is here relegated to an appendix, which refers to them as the pressures in use on systems already in operation, and to which, therefore, manufacturers have conformed; but it is stated that the question of standard pressures for new systems is under consideration. Another appendix relates to the highest internal temperatures attained and their relation to the maximum temperatures to which various classes of insulating materials may be subjected, these being in the case of impregnated cotton, silk, paper, etc., 105° C.; in the case of mica, asbestos, etc., 125° C.; and in the case of cotton, etc., not impregnated, 95° C. Enamelled wire is at present classed with impregnated cotton for want of reliable data as to its endurance, and the limits for refractory materials such as pure mica, porcelain and quartz are not yet determined. It is interesting, however, to note that the ability of mica and asbestos to withstand a temperature of 150° C. or more is recognised, though it is not considered advisable in the light of present knowledge to exceed 125° C. In this connection we may mention that at a recent meeting of the American Institute of Electrical Engineers it was stated that some of the generators at Niagara Falls which were built with mica insulation have been running for 20 years at temperatures up to 285° C. without injury, and some of the speakers advocated the acceptance of higher temperature rises for mica insulation than the A.I.E.E. rules allow. The machines referred to were wound with rigid bars, and it was pointed out that with modern high voltages and wire-wound coils it was difficult to insulate with mica, owing to the flexibility of the conductors. There was a decided consensus of opinion in favour of allowing a maximum temperature of 150° C. for mica and asbestos, but not more.

(To be continued.)

A NEW HIGH-EFFICIENCY INCANDESCENT LAMP.

By E. A. GIMINGHAM, M.I.E.E., and S. R. MULLARD, A.M.I.E.E.

(Abstract of Communication to the Journal of the Institution of Electrical Engineers.)

In 1913, experiments were started in the lamp research laboratory of the Edison & Swan United Electric Light Co. at their Ponders End works, with the object of making a lamp having the usual characteristics of the ordinary incandescent lamp, that is to say as regards the shape and size of bulb, stem, and cap, but having as the source of light an arc having electrodes of tungsten or other suitable refractory conductor burning in an inert gas such as nitrogen or argon. The present paper describes the results of this work.

The first lamps constructed were made with the electrodes in contact, one of the electrodes being connected to an expansion strip constructed of a strip of molybdenum, to one side of which was welded a thin strip of copper or other suitable material having about the same coefficient of expansion. A spiral filament of tungsten or molybdenum was mounted close to the strip and wired in series with the arc circuit. To prevent the strip moving too far and the arc breaking, a thick wire was sealed into the glass support; this wire acted as a stop and maintained the correct length of arc gap.

For alternating-current lamps the electrodes were constructed of fused tungsten and were of equal size.

For use with continuous current, in one form of lamp the positive electrode was constructed of a globule of fused tungsten, while the negative electrode consisted of a number of tungsten wires or filaments mounted in the form of a brush. The whole of the parts were assembled as shown in fig. 1, and sealed in an ordinary incandescent lamp bulb, which, after being thoroughly exhausted of air, was filled with nitrogen at a pressure of approximately two-thirds of an atmosphere.

When connected to a continuous-current circuit through a suitable resistance the current passing through the coil A produced sufficient heat to cause the expansion strip B to warp, thus separating the electrodes E, E, and striking an arc between them. The temperature of the heating coil then dropped to a very dull-red heat due to the added resistance of the arc itself. The heat from the arc was more than sufficient to keep the expansion strip hard against the stop F, and thus to maintain the requisite length of arc gap.

The arc burned steadily and the electrodes emitted an intense white light. The lamp had, however, many disadvantages, the most important being the tendency of the electrodes to stick together, with the result that the expansion strip failed to separate them slowly. Again, a considerable amount of sputtering took place when the electrodes separated, which, in consequence, shortened the life of the lamp. However, in the course of development, principally by altering the shape and size of the electrodes, a lamp was evolved from which a life of over 100 hours was obtained. Other attempts to overcome the sticking of the electrodes included altering the physical state of one electrode, also the use of a short-circuiting piece placed between them, which on the current passing was removed. These and other devices did not entirely overcome the troubles of sticking and sputtering.

The whole problem was then tackled from another direction. It was assumed, from the results so far obtained, that if the difficulties of striking could be overcome there were

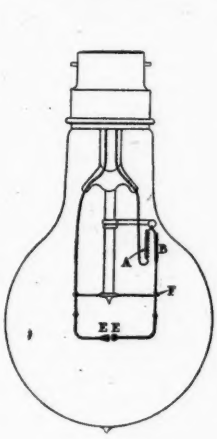


Fig. 1.

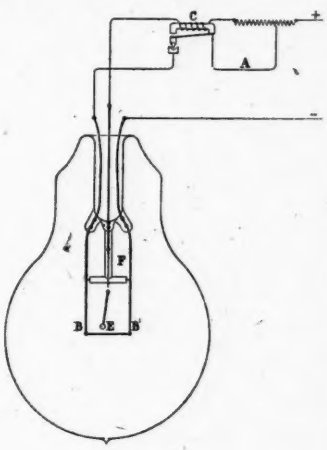


Fig. 2.

possibilities of obtaining a satisfactory source of light, the whole of the light emanating from a source of very small dimensions.

It is well known from the experiments of Sir J. J. Thomson, Dr. Fleming, and others, that the filament in an incandescent lamp gives off a strong negative discharge, and if an additional electrode sealed adjacent to the filament be charged to a positive potential, a current passes between the filament and this electrode. This principle was applied to overcome the difficulties encountered in making an arc incandescent lamp.

The first attempts on these lines were made with a lamp suitable for an alternating-current circuit. This lamp consisted of two small globules of tungsten fixed at a definite distance apart. As a means of breaking down the resistance of the gas within the arc gap, a filament was mounted adjacent to the electrode; this filament, when made to glow brightly for a few seconds, acted as an ionising agent and made the arc gap conducting.

As used in the lamp, this ionising circuit was connected in parallel with the arc circuit through an auxiliary single-pole switch and suitable resistance. On starting, the ionising circuit was completed for a few seconds and then broken by means of the switch. This resulted in an arc being momentarily struck between one of the electrodes and the filament, this being followed by an arc between both electrodes, the filament which acted as the ioniser being now entirely out of the circuit.

This lamp showed great improvement as regards both facility in striking and life.

Efforts were then directed to make a lamp for continuous-current circuits. At the start, the construction of this lamp was similar to that used for alternating current, with the exception that the negative electrode was smaller. To start the lamp the filament acting as the ioniser was brought to high incandescence and then cut out by means of a switch in the positive lead. Difficulties were experienced in inducing the arc to leave the tungsten-filament ioniser and pass to the negative electrode. This trouble was due to the difficulty of bringing the negative electrode to a temperature high enough to form an arc. In the alternating-current arc the electrode which momentarily formed the arc with the ioniser helped to form the arc proper, but with the continuous-current lamp the arc persisted in passing between the positive electrode and the ioniser.

Later on, negative electrodes were made, to which in the

majority of lamps the arc would strike, but it was felt necessary to provide thoroughly for the protection of the ioniser. This was desirable, inasmuch as the prolonged action of the arc tended to damage the ioniser, which after a time added to the difficulty of striking.

To try and obtain an ioniser which had a longer life than the previously used tungsten filament and which retained its activity throughout the life of the lamp, a study was made of the action of other materials than tungsten for use as an ioniser. It is well known that several refractory oxides possess to a very high degree the property of emitting electrons; experiments were therefore made with mixtures and combinations of tungsten with zirconia, yttria, thoria, and other oxides of the refractory class.

As a result of continued experiments, a satisfactory filament giving powerful ionisation properties was evolved, it being found that if the filaments were carefully made they were not destroyed by the action of the arc and that they lasted considerably longer than a filament of pure tungsten, this being no doubt due to the difference in the physical state of the two filaments. However, difficulties still remained in the matter of restarting. The action of the arc after a time naturally destroyed the ionising properties of the filament, and in some cases difficulty was experienced in restriking after 200 hours' burning. This deterioration of the ionising properties of the filament was only local, being merely around a short length directly opposite the anode.

To overcome this objection, a short length of expansion strip similar to that used in fig. 1 was linked between the anode and its stem lead. A lamp constructed in this manner is connected as shown in fig. 2, which illustrates a lamp suitable for a continuous-current circuit. Three leads are necessary through the lamp stem; on one is mounted the electrode E, while the other two hold the filament, acting as an ioniser, B B'. The positive main lead is divided into two circuits, one of which, A, passes through a resistance and the contacts on the electromagnetic switch C to one pole of the ioniser B, the other being taken through a resistance and the coil on the electromagnetic switch to the positive electrode of the arc circuit E. The negative main lead is connected to the remaining ioniser lead B'.

In operation, the current first passes through the ioniser circuit, causing the filament to incandesce at a temperature sufficient to ionise the gas between it and the positive elec-

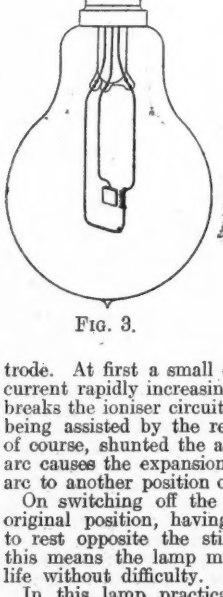


Fig. 3.

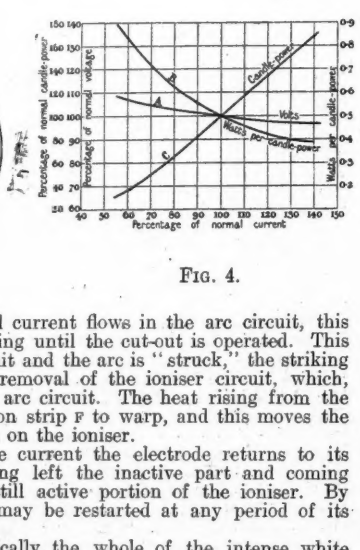


Fig. 4.

trode. At first a small current flows in the arc circuit, this current rapidly increasing until the cut-out is operated. This breaks the ioniser circuit and the arc is "struck," the striking being assisted by the removal of the ioniser circuit, which, of course, shunted the arc circuit. The heat rising from the arc causes the expansion strip F to warp, and this moves the arc to another position on the ioniser.

On switching off the current the electrode returns to its original position, having left the inactive part and coming to rest opposite the still active portion of the ioniser. By this means the lamp may be restarted at any period of its life without difficulty.

In this lamp practically the whole of the intense white light emanates from a small globule of fused tungsten 1/10 in. in diameter.

Any size or shape of electrode may be made, the construction of the higher candle-power lamps being arranged as shown in fig. 3. Here the expansion strip is dispensed with, use being made of the fact that in the more powerful arcs there is a greater tendency for the arc to pass across the shortest gap. In this case, after striking from the filament to the edge of the electrode, the arc rises to the thickened portion immediately opposite.

Another method adopted for controlling the arc stream in lamps of high candle-power is to employ an extra lead through the stem, holding a smaller electrode fixed between the positive plate and the filament, and situated at a definite distance from the former. By the operation of change-over switches in the circuit an arc is first struck between the filament as cathode and the small electrode as anode. On this electrode becoming brightly incandescent the change-over switch quickly operated brings into the circuit the large plate electrode, at the same time breaking the negative connection to the filament and changing the polarity of the small white-hot electrode. This latter now being negative, an arc is immediately formed between it and the large positive plate. This arrangement enables electrodes of any size to be used, and the filament being out of the circuit is completely protected.

A flat electrode is also employed. To obtain the best results a definite relation of surface to volume must be maintained. This type of lamp is made in sizes of 500 to 1,000 C.P., the maximum intensity being given in a direction at right angles to the plane of the electrode.

Comparison with Arc and Incandescent Lamps.—As compared with the carbon arc lamp no regulating mechanism is required, and there is therefore a saving in the initial cost of production. The loss of light due to obstruction by the electrodes is small compared with that in the carbon arc, and there is no trouble from flickering or from the arc wandering. The arc is completely enclosed, so that there is no danger from fire. No re-carboning is required, and the lamp needs no attention whilst in use. The light-giving surface for the same output is greater than the crater of the carbon arc, and the electrodes can be so arranged as to concentrate the light in any desired direction.

Filaments of incandescent lamps are always distributed round the stem and thus occupy a fairly large area, whereas in the new lamp the light-giving surfaces are concentrated in the centre of the bulb. In the same way that a carbon lamp appears yellow in comparison with the ordinary half-watt lamp, so does the latter appear yellow when contrasted with the new incandescent arc. For high candle-power lamps the bulbs are much smaller than for metal-filament lamps of corresponding candle-power, *e.g.*, electrodes to give 500 C.P. can be placed with safety in a bulb 4 in. in diameter.

Characteristics of Lamp, etc.—Curve A (fig. 4) shows the percentage variation of pressure with current. As will be seen, the curve is similar to that for an ordinary carbon arc, though showing greater stability. The pressure across the arc steadily decreases with an increase of current, and if this is continued until the sputtering point is reached, the pressure suddenly drops.

A representative efficiency curve is given by B in fig. 4, which shows the efficiency for the normal working current to be about 0.5 watt per International C.P., or 2 C.P. per watt. The current may be increased until the tungsten reaches the sputtering point, at which the efficiency is about 0.3 watt per C.P. or 3.33 C.P. per watt.

Curve C in fig. 4 shows the variation of C.P. with current.

Lamps have been made with a life of 500 hours, and it is hoped that further experiment will make it possible to obtain a true half-watt lamp with a life of 800 hours. During life the average decrease in C.P. is about 10 per cent.

Some experiments to determine the effect of varying the pressure across the supply mains show the arc to be very stable. A voltage drop of 20 per cent. in the case of the small lamps, and 25 per cent. in the larger sizes, was necessary before the arc was extinguished.

As compared with the carbon-filament lamp (3.5 watts per C.P.). with an intrinsic brilliancy of about 375 C.P. per square inch, and metal-filament lamps giving 1,000 C.P. per square inch, the intrinsic brilliancy of the new lamp at an efficiency of 0.5 watt per C.P., or 2 C.P. per watt, is approximately 10,000 C.P. per square inch. The colour of the light can be made to vary from a bright yellow when running at low efficiencies, to a very intense white light when the lamp is run to the sputtering point of the electrodes. The range of intrinsic brilliancy between these limits is approximately 400 to 30,000 C.P. per square inch.

Comparison with the spectra of various lamps clearly shows the continuity and strength in the visible spectrum of the new lamp, the other sources of light showing weakness in the green and at other points.

A great advantage of a lamp of this type is its adaptability (by altering the shape and position of the electrodes) for so varying the light distribution as to make it most suitable for the particular purpose for which the lamp is required. Where even illumination is required in all directions, spherical electrodes are most suitable. Electrodes can be made of any desired shape, however, and a flat plate or disk mounted vertically is an ideal light source for projection purposes.

The lamp is made for both alternating and continuous-current circuits, and the present intention of the Edison and Swan Co. is to put forward only the continuous-current lamp in its present form for optical projection and general scientific work where a concentrated point source of light is required. The lamp is so suitable for projection work that there is every reason to believe it will supersede all other sources of light for this purpose. It gives constant, uniform screen illumination, whilst there is no flickering and no danger of fire in kinematograph work, as there often is from the intense heat of the ordinary carbon arc. The bulb of the lamp, although smaller, does not become so hot as those of the half-watt metal-filament lamps. Moreover, the lamp requires no attention whilst burning, so that the whole of the operator's time is free to attend to his apparatus. Lamps of 1,000 to 2,000 C.P. are suggested as very suitable for kinematograph projection, and lamps of 200 to 300 C.P. for ordinary lantern work.

The lamp is very suitable for use in small searchlights, for daylight and night signalling, and as projection arcs for stage purposes. It should prove useful in photography, and for the purpose of colour-matching by artificial light. Microscope

illumination and micro-photographic work offer two fields of usefulness for the new lamp, and undoubtedly there are many special purposes for which the lamp is particularly adapted.

Experiments have shown that the lamp burns satisfactorily in series on high-voltage circuits, and future development lies in the adaptation of the lamp for street lighting, and for the illumination of large halls, etc.

Although much work remains to be done for the complete development of the lamp, and such development takes place slowly in these troublous times, the laboratory tests have clearly shown its commercial possibilities.

The authors are indebted to Dr. J. Fox for his valuable help in providing the photographs of the various spectra.

NOTES FROM CANADA.

[From our Special Correspondent.]

The Quebec Streams Commission a few months ago let a contract for the construction of a large concrete dam across the St. Maurice River, which flows into the St. Lawrence a little above the City of Quebec. The dam, however, will be about 240 miles up the river from its confluence with the St. Lawrence. The height of the dam will be 80 ft. maximum, and its length about 2,000 ft.; its cost is to be about $1,500,000. A storage reservoir will thus be created which will hold rather more than a cubic mile of water, giving a minimum flow of about 6,172 cu. ft. per second for 300 days. This reservoir, it is said, will be greater than that created by the Assouan dam.

The same Commission, by constructing a dam at a cost of about $100,000 across the foot of Lake St. Francis, on the east side of the St. Lawrence River, some 50 or 60 miles below Montreal, expect to secure effective regulation of the water powers available, thus increasing very considerably the power which may be developed. Power is generated at several points now, but during the winter the minimum flow is very much less than the flow in the spring, when the ice and snow melt. The proposed dam will provide a large storage area which will tend largely to balance up the available maximum and minimum flows.

On the Northern portion of Quebec Province, in the Ungava region, on the Great Whale river, which flows westward into Hudson Bay, occur a number of falls of comparatively high head. Within 20 miles of the mouth of this river are three falls of 150 ft., 230 ft., and 65 ft. respectively; at other points there are falls of 136, 170, and 315 ft. The Hamilton river, which flows into the Atlantic on the Labrador coast, has a sheer fall of 302 ft., while the fall of the river itself within a distance of 12 miles is another 460 ft.; the estimated power available due to this total fall of some 760 ft. is 300,000 h.p. This Ungava district is, however, too far away from any population, and is too cold, to admit of the development of these great water powers for a good while to come, unless it be done in certain cases for electro-chemical purposes, such as the fixation of atmospheric nitrogen, etc. There have already been brief accounts in some of the papers hinting at the proposed erection of a large power plant in Labrador for such work.

It is difficult to see how such a scheme could be made profitable unless both the power and the raw materials could be had almost for the asking, as the distance from available markets and the lack of transportation facilities would go a long way to offset cheap power and raw materials.

It is not usual to associate Canada with power possibilities derived from coal. The Provinces of the Middle West, however, being deprived by nature of the water powers so liberally possessed by Ontario, Quebec, and British Columbia, have instead coal deposits of no inconsiderable extent, though they are mostly of a low-grade quality, viz., lignites. Owing to the use of gas producers and gas engines the objections to lignite and coal of comparatively low calorific value is rapidly disappearing so far as power production is concerned.

Reference was made a year or more ago in this column to the Hudson Bay Railway, which will open up a new and much-needed route for grain shipments from the West. The idea, of course, is to transport the grain from the great wheat-growing areas to a port on Hudson Bay, and ship it thence to European ports. The interest of this railway line to electrical engineers lies in the fact that investigation is being made of water power sites along the route with a view to, possibly, building an electric line. Wireless stations have proved a great boon during construction, especially in enabling the men to be supplied with news of the world. The route will apparently be opened during 1917.

Women Workers.—The Liverpool Branch of the Electrical Contractors' Association on Wednesday last week decided to admit women to the industry. The branch decided that women should be trained in various branches of electrical work, and that they should receive their initial lesson in the first week in December.

THE PARK ROYAL ENGINEERING WORKS, LTD.

As many of our readers are aware, the firm of Spagnoletti, so well known in the past as a pioneer in certain directions of electrical manufacture, has now been merged into the Park Royal Engineering Works, Ltd., whose modern factory was completed during the present year. The original business established in 1851 had gradually expanded to such an extent that complete re-organisation and rebuilding were necessary, and as a result the new works, which we illustrate herewith, came into existence. These are laid out on the modern one-storey bay system, with ample north lighting, and are heated throughout by anthracite stoves.

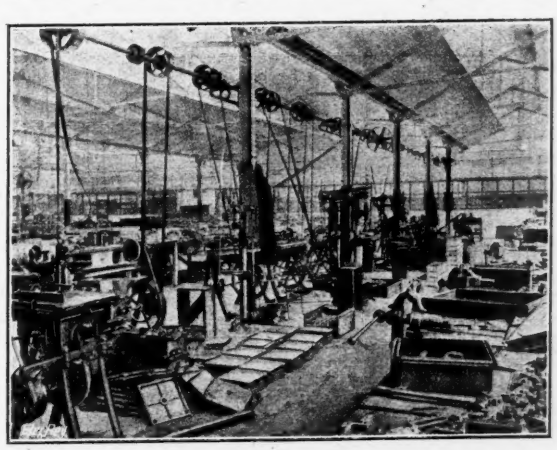
The machinery is electrically-driven throughout on the group system, with three-phase motors, and for artificial lighting both

Erecting Bay, Park Royal Works.

the half-watt and ordinary tungsten lamps are employed—in fact, advantage has been taken to introduce the best possible conditions for obtaining good work, and with very satisfactory results.

An up-to-date plant and machines, together with large test rooms, are provided; for testing and experimental work the equipment includes a large battery capable of every combination of connection, potentiometers, E.H.T.-transformers, and all the standard laboratory instruments.

Our view, fig. 2, illustrates a bay devoted to the manufacture of special fittings for ship work, such as bronze distribution boxes, junction boxes, terminal boxes, and ironclad switchgear; in close connection with this and the main erecting shop, is a light machine bay for dealing with the numerous small operations



Ship Fittings Department.

necessitated in switchboard erection and the fitting up of distribution and junction boxes.

Tramroads are provided for the distribution of material between the various departments. In recent years the firm has patented improvements in fool-proof switchgear for high-tension control; in other directions, particularly in connection with ironclad and mining electrical plant, important improvements have been incorporated, and are now regular features of the firm's standard designs.

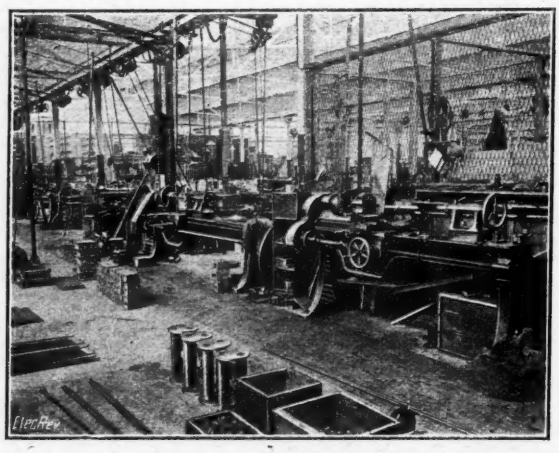
Bay 9 is devoted to the manufacture of circuit breakers, bells, portable telephone sets and wireless telegraph apparatus; in bay 10 the erection of steel-cased switch and distribution boards is carried out.

Fig. 3 shows a bay equipped with heavy lathes and automatic machinery, a portion of the tool stores being shown in the background; another bay at the northern end of the factory houses a number of drilling and milling machines.

E

A well-lighted instrument shop is provided, where the well-known voltmeters and ammeters, associated for so many years with the name of Spagnoletti, are manufactured; here also are assembled railway signal and telegraph instruments and other electrical precision instruments.

Adjoining are coil winding rooms for the winding of solenoids for switchgear and instruments. The lacquering departments and buffing houses are on the western side of the factory; hardwood



General Machinery Bay.

cabinet work in connection with teak and mahogany instrument cases is carried on in another department, as also pattern making in connection with the numerous small brass, gunmetal and malleable parts used in the firm's productions.

Well organised stores, separate paint and varnish shops and a mess room, are also included in the new works, which are exceptionally well situated in regard to railway facilities and mark a very great advance on those formerly in use at Shepherd's Bush.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The "Razzo" Hand Lamp.

A new single cell portable hand lamp, known as the "Razzo," has recently been introduced by the Equipment and Engineering Co., of 2, Norfolk Street, Strand, W.C. This is fitted with a 1½-volt

Fig. 1.—"Razzo" Lamp in use by Conductor.

bulb in an efficient reflector, which throws a beam of light to a very considerable distance, and should prove very useful for a variety of work under the present conditions of darkness. Fig. 1 indicates one of its uses, *i.e.*, that of enabling tramway conductors to punch their tickets accurately and give the right change.

Standard types of dry cell are used which can be obtained easily anywhere, and approximately 50 hours' light is given.

The lamp is made in three finishes: pressed steel (black), seamless brass (burnished finish), and seamless brass (nickel plated). It weighs complete 39 oz. and measures 2⅞ in. diameter by 9 in. long.

A New Insulating Material.

A new insulating substance known as Stern-Condensite is one of the latest additions to the field of moulded insulation. It belongs to the general class of substances made by reactions between phenol and one of the aldehydes, formaldehyde being the one used in this case. The Dickinson Manufacturing Co., of Springfield, Ill., U.S.A., which has been engaged in the production of electrical insulation and sundry composite parts for the past 40 years, is now turning out a large number of such parts in Stern-Condensite. The material is described as a plastic substance that can be readily moulded in its uncured state into any shape, with or without metal parts. After being cured under heat and pressure it leaves the mould in a finished state, presenting a lustrous black appearance like polished ebonite.

The "Migas" Detector.

The insistent demand for an apparatus capable of detecting the presence of gas in coal mines, and measuring its amount, has led many inventors to apply their talents to the solution of this problem; amongst these Messrs. Arnold Philip and L. J. Steele appear to have met with exceptional success, judging by the claims put forward for the "Migas" detector, which has just been put on the market by The General Electric Co, Ltd., of 67, Queen Victoria Street, E.C. The Coal Mines Act of 1911 laid down certain limits for the amount of gas that might be present under

Fig. 2.—The "Migas" Mine Gas Detector.

specified circumstances, which range from 0·25 to 2·5 per cent.; the "Migas" detector, we are informed, by direct reading indicates any percentage of inflammable gas between 0·02 and 3 per cent., thus covering the whole range, to a degree of accuracy within 0·03 per cent. The readings, it is claimed, are fully equal in accuracy to the results obtained by the most careful chemical analysis, and are obtained at once, whereas analysis involves reference to surface laboratories and a delay of at least an hour from the time of taking a sample, even supposing that the colliery possesses a chemical laboratory, which is not often the case. With the detector a reading at any point can be made within 15 seconds. We illustrate the instrument herewith; it is strongly made and quite portable, weighing only about 13 lb., and can be used by observers without any special training. Assuming that it is as good as it is said to be, the instrument will be of immense value to colliery managers.

Automatic Electric Furnaces.

In the heat treatment of special tool steels it is important to eliminate the personal factor as far as possible, so that the result may not depend upon the skill of a workman. At a recent meeting of the American Iron and Steel Institute (reported in *Met. and Chem. Engineering*) Mr. T. F. Baily described an automatic electric heating furnace provided with special pyrometers which actuate electrically-controlled hydraulic valves when the material has reached the proper temperature, and discharge the steel for

quenching. The furnace has shown a thermal efficiency of 92½ per cent. The pyrometer is placed ½ in. from the metal at the point of discharge, and so liberal a period is allowed for heating up that the piece is heated uniformly throughout, there being therefore no material difference between the temperature of the pyrometer and that of the steel.

ELECTRICAL ACCIDENTS IN 1914.

(*Concluded from page 714.*)

THE corresponding accidents to unskilled persons are less excusable, as the men should not have been allowed to attempt the work. In many works, sometimes even in large works using a very considerable amount of electric power, no technically qualified person is employed, and unskilled workmen are consequently permitted to attempt repairs or alterations at great risk to themselves. The two fatalities occurred on travelling cranes. In one case the driver was oiling the gear on the crab whilst the conductors were live, and in the other a fitter was repairing the crane and came into contact with the live trolley wires. In both cases the system was 440 volts, three-phase. Of the non-fatal accidents the victims were described as labourers (13), fitters (9), bricksetters, oilers, &c. They were mostly attempting to do some work on the electrical apparatus for which they were quite incompetent.

That the testing of electrical apparatus in electrical manufacturing works is largely carried on by apprentices and pupils is again indicated by the ages of the persons meeting with accidents. The fatal accident occurred, however, to an experienced electrician, who touched wires at 2,000 volts apparently under the impression that they were dead. Artificial respiration was carried on for two hours without success. In another case a man touched some testing leads at 12,000 volts pressure. He was rendered unconscious, but was brought round by artificial respiration. In the other cases the injuries were mostly burns from short circuits. The testing departments of electrical manufacturing works are often carried on in a very unsatisfactory manner. There is unnecessary exposure of live conductors where they are liable to be accidentally touched. Any old connecting cables with damaged insulation are considered good enough. Even in high-pressure testing unnecessary risks are run. In one large armature winding shop it was customary to test the armatures by applying 2,000 volts between the commutator and the spindle. A twin flexible cable was connected to a transformer in a cabin, the other end being moved about to whatever part of the shop a test was required, perhaps 20 or 30 yards from the cabin. The cable terminated in bare ends projecting from short vulcanite sleeves. There was only one tester, who could, of course, not be at both ends of the cable at the same time. An accident occurred at an armature under test, the armature winder, who was applying the ends of the test leads, getting a shock. The tester was walking back to the test cabin, where, at the moment, there was no one to switch off the current. In this shop, also, there was no one qualified or instructed in first aid methods, someone having to be fetched from another department of the works.

Amongst the miscellaneous accidents there were three fatalities. One occurred to an electrician in a large iron works in switching on a lighting circuit transformer, arranged across one phase of a 460-volt, three-phase system, at a totally enclosed ironclad switch, the case of which was not earthed. The switch was of a well-known type, having fuses in the same box so arranged that when the switch is in the "off" position the fuses are withdrawn from the contacts, and by opening the cover they can be renewed in safety. The apparatus was intended by the makers for use with cartridge type fuses. As so often happens, however, the cartridge fuses had been replaced by wires. The electrician in question had the duty of switching on the lights at dusk, and, in order to prevent other employés switching on before the proper time, it appears that he had disconnected one end of one of the fuse wires, and had closed the cover of the switch. Later on, when he went to turn on the lights, he had evidently forgotten that the fuse was disconnected, and the effect of putting the switch to the "on" position was to make the fuse-wire live, and bring it into contact with the metal case, giving him at the same time a shock, which proved fatal. The accident would, no doubt, have occurred to any other employé attempting to turn on the lights. At the inquest it was urged that the apparatus was advertised as being "fool-proof." It is evident that this description requires some qualification. In the second fatal case the man received a shock from a 200-volt two-phase motor, the frame of which was live and not earthed. He was about to start up the motor, and had turned on the main switch but not the starting switch. He was engaged in shifting the belt on to a loose pulley, and his hand was trapped between the pulley and the belt. A man who went to his rescue also received a shock. The third fatality occurred to a boy who climbed up on to a roof where he had no business, and took hold of two wires of a 440-volt three-phase system. Amongst the non-fatal accidents two were due to stay wires of poles becoming live. In one case an electrical engineer took hold of a stay wire and was unable to let go. His two assistants, who were fortunately at hand, succeeded in pulling him off by his clothes. The system was 440 volts three-phase, and the leakage was due to the failure of an insulator.

Amongst the electric shock accidents there were several cases where the victim was brought round by means of artificial respiration. On the other hand, in several of the cases which ended fatally no adequate measures were taken to attempt to restore animation. In one case the patient was sent on an ambulance to the hospital, where the doctor pronounced him dead. At the inquest the doctor stated that as he was informed that the man had received a 5,000-volt shock, it would have been of no use if artificial respiration had been carried out in the first instance. In another case (440 volts three-phase) artificial respiration was started by the employés. Fifteen minutes after the accident a doctor arrived and pronounced the victim dead, and no further efforts at resuscitation were made. In another case (200 volts two-phase) artificial respiration was conducted until a doctor, ten minutes afterwards, pronounced life extinct, and no further efforts were made. Similarly in two other cases efforts were abandoned after 25 and 30 minutes respectively, on the doctor pronouncing the patient dead. In my report two years ago I drew attention to a letter by Dr. Reginald Morton, which appeared in the *Lancet* and other papers, pointing out that death from electric shock is in general at first only apparent, and that by means of artificial respiration, promptly and carefully carried out, patients may often be revived, even as long as two hours from the time of the accident. In general, however, the medical profession appears to be somewhat ignorant on this matter, with the result that in many cases adequate efforts at resuscitation are not carried out.

TABLE III.—SHOWING VOLTAGE AND SYSTEM IN FATAL CASES

Number of fatalities.		Voltage of system.	Voltage of circuit or probable voltage of shock.	System.
1*	...	6,600	500	3-phase
1	...	5,000	2,900	"
1	...	2,000	1,150	"
1	...	2 400	2,400	1-phase
1	...	2,000	2,000	"
1	...	500	290	3-phase
1	...	460	265	"
2	...	440	440	"
7†	...	440	250	"
1	...	400	400	"
1	...	400	230	"
1	...	240	140	"
1‡	...	200	200	2-phase
20				

* Shock from neutral conductor. † 1 fall due to shock. ‡ 1 fall due to shock.

It will be noticed that all the fatalities were due to shock from alternating current; 18 were due directly to shock and two to fall following shock. Fifteen were from pressures of 440 volts or less. Most of the shocks being to earth from touching one conductor only of the system, the voltage received by the victim was less than the voltage between phases.

In my visits during the year I again found numerous examples of dangerous switchgear and other apparatus contravening the requirements of the Regulations. In high-pressure and extra-high-pressure stations switchboards without any protection of conductors within easy reach of persons in the passage-ways were noted. In one case there were bare conductors at 10,000 volts along one wall with a gangway about 3 ft. wide; a single iron rail 12 in. out was all the protection. At the far end there were isolating switches requiring to be operated at intervals of a few days, necessitating the use of the passage while the conductors were live. In another case, although the passage was wider, there was not even a hand-rail. The excuse sometimes offered is that only authorised persons are allowed in the passage-ways. When an accident happens to the authorised person, and experience shows that such persons are by no means immune, he is blamed for not having been more careful. In one case such a passage-way was also used as a store room. Sometimes where bus-bars and isolating switches are placed out of reach from the floor, lamps for lighting the passage-ways are placed close to them, so that when a lamp fails and requires renewing the attendant will have to get up dangerously close to the live conductors. In some cases where the protection was adequate as regards ordinary routine operations and inspection, and where duplicate bus-bars were provided, the arrangement was such that when cleaning or other work should have to be done the advantage of the duplicate bars was lost. Thus the generator and feeder cells were arranged for connecting to either set of bus-bars by selector switches. Both sets of selector switches were, however, in the same compartment, and the two sets of bus-bars were not separated, so that when it should become necessary to clean the insulators of the isolating switches or bus-bars or otherwise work upon them, it would be necessary to shut down on both sets and therefore to stop the supply. This point has been overlooked in a number of public supply stations from which the supply is supposed to be continuous. In some cases a still more obvious mistake has been made in putting the isolating switches in the same compartment with the oil switches, so that unless special screens are provided for covering up the live side of the isolating switches, which is not always practicable, an oil switch cannot be overhauled without shutting down the whole switchboard. On a 2,000-volt direct-current switchboard there were double-pole switches having exposed blades 5 in. apart with the handle arranged as a cross piece between. Although there was a flange at each end of the handle, the arrangement was obviously very dangerous.

Further examples of medium pressure three-phase switchboards, mostly with oil switches, were found on works where the supply

had to be maintained continuously, including night time and Sundays, and where no provision was made for isolating the oil switches or other parts when any work should become necessary. On some switchboards, fuses, even for main circuits, were placed at the back in positions (*e.g.*, between the bus-bars and the slate panels) where they could not be reached without danger. On a 550-volt switchboard having three rows of double-pole switches, the switches of the lower rows were arranged so that their handles came between the blades of the switches in the row above. In a works using large electric welders, the primary switchboards, 440 volts alternating, having bare switches, fuses, &c., were placed behind the welders, where they could only be reached by standing on the welding machines, and where the metal hoops being handled would be liable to be accidentally brought into contact with them. At a large new dock, the cranes had bare switchboards in the confined space of the driving cabins. The connector plugs for the main cables to the cranes were not protected by switches, and were so designed as to be liable to short circuit on plugging in. The most common faults in works concern the distribution fuseboards. Fuse-holders which cannot be handled without risk of touching live metal, and in which the fuse-wires are unprotected, are still supplied for new installations. In one 400-volt, three-phase installation, cartridge fuses with thumb-screw terminals were found in iron cabinets and over non-insulating floors. In a timber yard having portable electric saw-benches out of doors on a 440-volt, three-phase system, the flexible conductors were not protected by switches, and the fuses were of a type dangerous to handle, and the metal saw-benches were not earthed.

LEGAL.

Electrical Machinery for China Stopped.

A quantity of electric light apparatus intended for Chinese public lighting installations was the subject of an application in the Prize Court on December 2nd, when the President, Sir Samuel Evans, was asked by the Crown, under Article 4 of the Reprisal Order, to require the sale of this machinery and payment into Court of the proceeds.

The machinery had been seized at North Shields on board the Danish steamer *Cathay*, shipped at Copenhagen, Christiania and Gothenburg.

Mr. D. Stephens, counsel for the Crown, stated that the vessel contained all kinds of machinery manufactured in Germany, and a miscellaneous collection ranging from electric light plant to Epsom salts.

Mr. Dunlop, on behalf of the Electric Lighting Co., of Pekin, asked for the release of a quantity of electrical machinery. The packages captured included 21 packages of installation machinery, made to order for the public electric lighting company, of Pekin. The firm paid £3,300 for the machinery on July 18th of this year. It was made by Messrs. Koerting Bros., of Hanover, and the Allgemeine-Elektricitäts Gesellschaft, of Berlin. There was no defiance of any Order in Council; the goods were sold before the war. To sell the machinery now, according to the Crown's request, would be destructive of the neutrals' right to the release of the goods. The machinery was made to specification, and would be of little value to purchasers in this country. In Pekin it was badly wanted.

His Lordship said he would have this machinery detained until the claimants had elaborated their proof.

Fourteen packages of machinery and 10 packages of pumping appliances for the Tientsin Native City Waterworks, Ltd., were ordered to be detained. They had been shipped by A. Borsig, of Tegel, and 16 cases of electrical appliances for the Sunkiang Electric Light Co., Shanghai, were ordered to be sold. These were shipped by the firm of Siemens, of Berlin, and the President made the remark that they were chiefly fittings and smaller pieces in general requirement, and would sell as readily in this country as in China.

Tramway Accident Claim.

Before a jury, in the Court of Session, Edinburgh, a Glasgow woman claimed from the Corporation of Glasgow £500 damages in respect of personal injuries. She stated that a car on which she travelled overshot a stopping place, and was stopped so suddenly that she was thrown against the front of the inside of the car and injured. For the Corporation, it was stated that the car stopped before the stopping place was reached, that the woman had no occasion to rise when she did, and that she should have held on by the straps or bars. The jury returned a verdict for pursuer and assessed the damages at £300.

Motor Supply Used for Lighting.

At Dewsbury Borough Court, on November 30th, George Strecker, trading as M. Strecker & Son, pork butchers, Dewsbury, was summoned by the Corporation on an allegation that he fraudulently took a lighting supply from his motor supply after his lighting meter had been disconnected. The Town Clerk said the summons was taken out under Sec. 23 of the Electric Lighting Act, 1882, which was to the effect that a person who committed an offence under the Act was guilty of simple larceny. He described the offence as a serious one. Previous to March, 1912, defendant used electricity both for power and lighting purposes, and the charge for the latter was 1½d. per unit higher than for motive power. In March, 1912, the electrical engineer received a letter from Strecker to the effect that he would not require electric light again, so his meter was disconnected. On November 14th of this year, however, two electrical inspectors and a constable visited defendant's premises, and, seeing the sitting-room over the shop lighted up, went in. On inspection, they found that the electric light was connected to the ordinary fittings by a flexible wire to the cut-outs controlling the motor for a sausage chopping machine. They further found that the flexible had been continued to two more lampholders, which were, however, without globes. On defendant agreeing to pay £1 15s. which the Corporation claimed, the Bench allowed the case to be withdrawn.

Electro-Generator Co., Ltd., *v.* Erman.

On Monday, before his Honour Sir W. Lucius Selfe, in the West London County Court, the Electro-Generator Co., Ltd., of Shepherd's Bush Road, W., contractors for electric power installations, sued M. Erman & Son, electrical engineers, Thames Ironworks, Blackheath, for £13 6s. 6d., balance of an account. Counsel for the plaintiff company explained that the claim was admitted, but the defendants had a counterclaim for £55, the price of a motor which had been returned.

After the case had been heard at some length, the luncheon interval was reached. On the Court resuming, Counsel announced that during the interval the claim and counterclaim had been settled on terms marked on Counsel's brief. The record was then withdrawn, and the case dropped.

Munitions Act Case.

At a meeting of the Munitions Tribunal for Edinburgh and District, Andrew Wark, fitter with Bruce Peebles & Co., applied for a certificate, alleging various reasons for the application. The representatives of the employers said they had no desire to keep this man on account of the quality of his work. If he had applied to the firm he would have received a certificate right away. The first the firm knew of the man's desire to get away was the application to the Court. Sir Andrew Fraser, the President, said the Tribunal could not give a certificate as applied for, but the firm of course, could give one.

British Electric Traction Co., Ltd.

Mr. Justice Astbury, on Tuesday, resumed the hearing of the petition for confirmation of the reduction of the capital of the above company, and for the sanction of a scheme of arrangement. Mr. Russell, K.C., addressed the Court for the company, and Mr. Clauson, K.C., opposed on behalf of the income certificate holders. The hearing was adjourned to Wednesday.

MAKING AND USING THERMOCOUPLES.

By F. G. COBURN.*

Platinum wire for rare-metal thermocouples should be chemically pure, 0.6 millimetre in diameter—and all wire bought at any one time should be specified to be in one length and drawn from one ingot. The platinum-rhodium wire should also be 0.6 millimetre in diameter, and should be 90 per cent. chemically pure platinum, alloyed with 10 per cent. chemically pure rhodium. These wires are expensive. One and one-half ounces of this wire equals about 25 ft., and an ordinary rare-metal couple for laboratory work should be about 4 ft. in length.

The advantage in specifying that all the wire of any one kind bought at any one time shall be in one piece and drawn from one ingot is that, having two such wires and making up a thermocouple from the wire at each end, they may be compared with a standard, and the resulting curve used for all thermocouples made from that lot of wire. It is then simply necessary to check one point on the curve, such as the melting point of salt, or get a comparison in the furnace for one point.

The iron and constantan combination has two great advantages: low price and reasonable uniformity. Iron wire for thermocouples should be 0.172 in. in diameter. The constantan wire may be the same size or, if desired, one or two gauges smaller. These two kinds of wire should also be specified to come in one length and be drawn from one ingot, to save thorough comparison of each couple made, and it should further be specified that the wire of each kind be thermo-electrically uniform along its length. Any variation in the wire, such as slag particles or difference in internal stresses, may give rise to parasitic currents.

If both ends of a length of wire are taken to a millivolt meter and a plumber's torch is passed along the line, the electromotive forces generated up to a bright-red heat should not be equivalent to more than 10 deg. C., or 18 deg. F., in either direction. It is a good plan, also, to require that wire furnished shall be, within this tolerance, thermo-electrically equal to the wire in use. That is to say, if a piece of iron wire being purchased is fused to a piece of iron wire in use, the couple thus formed should not show an electromotive force equivalent on the iron and constantan scale equal to more than 10 deg. C. when the junction is heated to approximately 1,000 deg. C. By maintaining uniformity in this way

* In the *American Machinist*.

all the couples in the plant are very nearly alike, and better results will be secured from the installation.

A piece of each kind of wire having been cut to the length of the desired platinum-rhodium thermocouple, the hot junction should be formed by fusing the two ends together. This may be done with the oxyhydric blowpipe, in the electric arc, or in the oxyacetylene flame. The fusion should be complete, and it is well to have at the junction a button about the size of a pinhead. The junction having been made, a current should be passed through the two wires to anneal them, from 12 to 15 amp. being sufficient. Sometimes makers of thermocouples twist the ends together before fusing; but this is bad practice, for a thermo-electric contact will be made in the twist, at some distance back from the fused junction, and such a contact is bound to give trouble.

One of the two wires of the couple should be encased in a small insulating tube and the two wires inserted in an outside tube or sheath. These tubes may be of porcelain or of fused silica. In either case the outer tube or sheath must be glazed on the outside. Porcelain is the best, and if used it should be the genuine Marquardt mass or Royal Berlin porcelain. This material is gas-tight, and will stand a temperature of about 1,300 deg. C., far beyond the range that the iron and steel metallurgist usually has occasion to go. These tubes are very fragile, however, particularly when hot, and do not endure rapid temperature changes.

If silica tubes are used, they should be made of pure fused silica, such as will not be affected by nitric, muriatic, sulphuric, or acetic acids, ammonia, or organic acids of any strength, and absolutely insoluble in water; and the coefficient of expansion should be sufficiently low so that the couples may be subjected to sudden temperature changes without danger of breaking. Up to 1,100 or 1,200 deg. C. these tubes are satisfactory. Above that temperature the silica breaks down and the platinum is attacked.

The reason for enclosing a rare-metal thermocouple in a gas-tight sheath is that the furnace gases, and particularly those in the iron or steel-treating furnace, attack the platinum and shorten its life very rapidly, and also change the thermo-electric characteristics of the couple.

If the couple is to be used under conditions previously described, it must be covered by a black iron pipe sheath ¾ in. or 1 in. in diameter; and for exceedingly high temperatures, such as that of iron at welding heat, where the couple is to be in constant service, a thick graphite sheath may be necessary.

The design of the head is a purely mechanical proposition. It must be such as to hold the porcelain or silica sheath, and also the iron sheath, if one is used, and must carry the wires through without a possibility of short-circuiting them. Where connections to the couples are to be made and broken at all frequently, it is well to design the head so that the lead wires are terminated in a double plug fitted into sockets in the head, and in this case the connections should be made non-reversible, either by using flat plugs with their planes at right angles to each other or cylindrical plugs of different diameters. The former type is a stock article in ordinary porcelain and does very well, but there is considerable danger of breakage.

In the construction of base-metal couples, the hot junction should be made by welding, in practically the same way as the rare-metal junction. Where the equipment is available, an electric butt weld is admirable, because it is quickly and effectively made and is very durable. The wire should not be twisted. It is not necessary to anneal an iron and constantan couple.

Since the base-metal couple need not be enclosed in a silica sheath, unless it is to be used in a furnace where there are gases that would attack the metals, it is sufficient to enclose the couple in a black iron pipe sheath, and to prevent short-circuiting it is best to put insulators on both wires. These insulators should be about 1 in. long, about ⅜ in. outside diameter, and about 0.2 in. bore, of porcelain, such that they will not break down at any temperature up to 1,000 deg. C. The same remarks regarding the head apply to these couples as to rare-metal couples. It should be noted that for laboratory work it is not necessary to furnish heads, as the wires themselves will lead directly to the icebox for connection.

As has already been emphasised, the cold junction temperature is very important. On an annealing furnace in the shop, for example, where there are a number of thermocouples, the cold junctions would all be carried to one point and there enclosed in a box into which a thermometer projects, so that the cold junctions of all the couples are the same, and so that the temperature may be known and allowed for. If rare-metal couples are in use, the lead wires from the heads to the cold junction box should be of copper wire, as at ordinary temperatures the thermo-electromotive force between platinum and copper and between platinum-rhodium and copper is inconsiderable.

Where iron and constantan couples are used, the lead wires should be of iron and constantan wire respectively; but they may be much smaller than the thermocouple wires themselves. A diameter of 0.051 in. is ample. The wire may be obtained in the form of a rubber or braid-covered twin conductor, which is a very convenient form indeed. The wire thus purchased should be compared thermo-electrically to the corresponding wires of the thermocouples, to see whether it will show, for any temperature up to that obtaining around the outside of the furnace, any thermo-electromotive forces between corresponding wires. There are devices now on the market for maintaining a constant cold junction temperature. These devices consist principally of a closed box with binding posts or similar arrangements for making the connections between the lead wires and the wires going to the galvanometer, and a small incandescent lamp with a thermostatic switch in its circuit, this switch being inside the box. The switch being adjusted to any given temperature, it will close when the temperature in the box goes below that point, thus turning on the lamp; and when the temperature has reached the upper limit the circuit will open. Regulation to within ½ deg. F. is claimed for this device, and in an installation using galvanometers it is very valuable. These devices are not cheap by any means, but an ingenious electrician can construct one, as the thermostatic switches may be purchased at a nominal price.

For laboratory work the temperature of melting ice is the best at which to maintain the cold junctions, because all calculations are referred to this standard, assuming that the Centigrade scale is used in all laboratory and scientific work. No allowances are necessary. The simplest way to make the connection is to provide a good-sized glass bottle, of about a quart capacity, having a mouth about 2½ in. in diameter, with the cork bored for small test tubes. These test tubes should be filled with mercury and the bottle filled with shaved ice, which should have some water in it. Then one thermocouple wire is pushed down into one test tube full of mercury, and the lead wire from the galvanometer or potentiometer is also pushed down into the mercury, making the junction in mercury at 0 deg. C. It should be noted that the wire from the measuring instrument should be insulated right down to its tip. If the bare wire were used, the junction would be made at the surface of the mercury, which might or might not be at 0 deg. C. It probably would not be.

This glass bottle may then be set in a bucket and packed around with waste. The ice will remain for two or three hours, provided there is no source of heat near by. But it is better to use a Thermos bottle instead of the ordinary glass bottle, as then the 0 deg. C. temperature may be maintained for hours.

No equipment is complete without standard couples of platinum and platinum-rhodium wire. These standard couples should be at least three in number: one to be used as the primary standard, the other two as secondary standards. All comparisons should be made with one of the secondary standards and occasionally the two secondary standards should be compared with each other. If they show any difference, they should both be compared with the primary standard, to see which one is out; and this is the only use to which the primary standard should be put. The rest of the time it should be, figuratively speaking, packed in cotton and kept in the safe.

In addition to these three standards, there should be one or more standard base-metal couples, for convenience in comparing other base-metal couples with the standard. It is not necessary to provide sheaths and insulators permanently for the standard couples. They should be kept hung up in a locker.

DIESEL ENGINE USERS' ASSOCIATION.

At the November meeting of the Association, the acting hon. secretary reported the names of further undertakings and firms who had joined in the movement to endeavour to obtain more favourable terms from the Inland Revenue authorities in the matter of the allowance off profits for depreciation of Diesel engine plant before assessment for income-tax purposes. In this connection, it was pointed out that the present inadequate allowance of only 5 per cent. on the diminishing or written-down value of the plant corresponded to an assumed life of 58 years for Diesel engines if the residual value of the plant at the end of the term was taken to be 5 per cent. of the original value. The allowance of 15 per cent. recommended by the Association as fair and reasonable under the circumstances corresponded to an assumed life of 18 years for the plant.

The discussion on the subject of cracked and seized pistons was resumed by Mr. J. M. Ferguson, who had been invited to attend the meeting. He spoke of the practice and experience of Messrs. Willans & Robinson, Ltd., on these points, and laid stress on the great importance of using metal of the special quality necessary for pistons of Diesel engines. He considered that the casting should be carried out in the engine maker's own foundry, under his direct control and supervision. He also referred to an arrangement devised and patented by Mr. P. H. Smith for a renewable plug or core in the piston head.

Mr. P. H. Smith, who also attended the meeting by invitation, remarked that the fundamental cause of cracks in Diesel engine pistons was a highly heated core trying to expand, but being restricted in so doing by a comparatively cold and very stiff ring of metal surrounding it. The consequence of the core attaining a higher temperature than that of the remainder of the metal of the piston was distortion and buckling, and in cooling after the engine was shut down the core did not quite resume its original unstrained condition. This action being progressive with alternate heating and

cooling, the stresses became higher until fracture occurred. It was noticeable that Diesel engines working continuously day and night gave very little trouble from cracked pistons as compared with other similar engines working more intermittently. Some makers were endeavouring to find a cast-iron for pistons which would not "grow" on repeated heating and cooling. Such an iron was very pure, high in manganese, and low in silicon, and, being mainly of Swedish origin, was practically unobtainable at the present time. Although Mr. P. H. Smith thought that there was much to be said in favour of using such a class of iron, he did not think that the ultimate solution of the trouble of cracked pistons would be found in the adoption of any particular grade of cast-iron. He then referred to two general systems of piston construction which had found favour in the case of larger sizes of pistons, namely, pistons with renewable heads, and water-cooled pistons. He himself had not much faith in the renewable head, though it had some advantages. The renewable head was introduced, not so much with the idea of preventing fractures as to reduce the cost of replacing a fractured piston. It did not remove the cause of cracking, as there was still the very hot core surrounded by a stiff colder ring, though it must be admitted that some renewable heads were designed in such a manner as to carry away a greater amount of heat from the hot core than was possible with ordinary methods of piston construction. He considered that a further objection to the renewable head was that the quality of metal selected on account of its resistance to a tendency to fracture being usually soft, it would probably be liable to burn in the centre, and the wear in the ring grooves in the softer metal would also be more rapid. He then described his arrangement of a renewable core in the piston head, which had already been referred to by Mr. J. M. Ferguson, and which he considered would provide a solution to the trouble of cracking. This is made in two parts so as to reduce stresses to a minimum in the core as well as in the piston. The core proper, or inner portion, is fixed on to a recess in the piston head by a gas-tight joint well removed from the region of highest temperature, and is surrounded by a separate annular ring. The core is free to expand laterally and longitudinally, and the annular ring is similarly unrestricted. To reduce any tendency to crack in the remaining portion of the piston head, the recess which contains the core is stepped, the depths of the steps gradually increasing, and the top edge of the recess is sufficiently removed from the hottest region to avoid cracking or fraying out. In the larger sizes of pistons, the difficulty was to avoid not only cracking, but also seizure, and, in Mr P. H. Smith's opinion, all Diesel engine pistons exceeding 16 in. in diameter should be water-cooled or oil-cooled if the mean effective pressure was as high as 95 to 100 lb. per square inch.

The discussion was continued by other members.

BUSINESS NOTES.

Lamp Shade.—Messrs. Pope's Electric Lamp Co., Ltd., Hyde Road, Willesden, have issued a shade for electric lamps, to enable consumers to comply with the prevailing restricted lighting regulations. A supply of such shades will be sent to any buyer or seller of the lamps on application.

Board of Trade Inquiry.—A Sydney local agent wishes to obtain agencies for British manufacturers of electrical machinery and apparatus, particularly wire-drawn lamps. Particulars can be obtained from the Board of Trade Commercial Intelligence Branch in London, quoting reference C.I.B. 55,495.

Aluminium Works in Norway.—It is reported that the Council of State of Norway has granted a concession to the Hoyang Faldene Norsk Aluminium Co. to acquire and work the Hoyang-Elys. The company is to have a share capital of £659,000, of which banking interests have guaranteed £219,000, and preliminary applications for shares for £273,000 have been made by Norwegian capitalists. It is calculated that the output of aluminium will amount to 4,000 tons per annum.

Catalogues and Lists.—The Dowsing Radiant Heat Co., Ltd., 39 and 40, York Place, Baker Street, London, W.—68-page well-illustrated catalogue and price list of electric heating and cooking apparatus, including hot-bar radiators, luminous electric radiators, convectors, and radio-convectors, electric cooking ranges, kettles, grills, sterilisers, and other utensils, and various accessories for use in connection with heating and cooking installation work. A green-covered booklet of 32 pages, entitled "Economise by Using Electricity," shows and gives prices and concisely stated particulars of a variety of Dowsing domestic devices. The company, in addition to having taken over last year the business of Messrs. Eastman & Warne, have recently purchased that of the Phœnix Electric Heating Co., and they have now acquired the goodwill, patterns, secret processes for manufacturing heating elements, also the drawings and stock of heating elements, of the British Prometheus Co. When they have sufficiently extended their works they will be able to supply heating elements previously made by these firms.

Messrs. Townshends, Ltd., Ernest Street, Holloway Head, Birmingham.—New list illustrating and giving prices of electric light fittings for industrial use, shop-lighting, &c., including half-watt lanterns, enclosed and open types, reflectors for metal-filament lamps, &c.

Messrs. Willans & Robinson, Ltd., Rugby.—42-page illustrated catalogue containing full descriptive particulars, half-tone and line illustrations, sizes, code-words, &c., respecting the Willans-Oddie Simplex direct-acting steam pumps. The valve gear and its action are detailed, also its advantages. The information relates to standard sizes of boiler-feed pumps, compound pumps, hydraulic pumps, and service pumps. Some pages are devoted to the arranging and fitting up of pumps, the setting of the valve gear, re-setting without centre dabs, and some other matters. Code-words for parts, and a list of metric equivalents of dimensions given in the pamphlet, are included.

"Z" Electric Lamp Manufacturing Co., Ltd., Standen Road, Southfields, S.W.—Folding sheet notifying the trade concerning their publicity and advertising efforts, past, present and to come, and giving particulars and a composite illustration of their various specimens of publicity literature that are available.

The Century Electric Co., St. Louis, U.S.A.—Illustrated circular showing their small single-phase motors driving respectively a cream separator, potato peeler, refrigerator, &c.

Messrs. Siemens Bros. Dynamo Works, Ltd., of 38 and 39, Upper Thames Street, E.C., have issued a new Wotan showcard for trade display. It is of attractive design, and is provided with a collapsible box arrangement having a black velvet background against which a cut-out of the Wotan lamp is silhouetted. It is produced in effective colours, and is of handy size (11 in. by 7½ in.) for use for counter, desk or window display. Copies will be supplied to customers on application.

Long-Suffering Motors.—What a well-made motor will stand is exemplified by the case of a mill, the whole of the plant in which was electrically driven by Crompton motors, installed many years ago. A group of four motors, installed on the second floor of the mill, was accidentally precipitated to the basement, and the building caught fire. After the flames had been extinguished, the motors were taken from the débris with a view to making use of them, if at all possible, in a temporary mill. After refilling the bearings with oil and replacing some of the brushes, it was found that all the motors were in satisfactory running order. The motors in question were installed a long time ago, and they have been superseded by a more up-to-date design by Messrs. Crompton & Co., attention having been given to high efficiency, low temperature rise, and large overload capacity with sparkless commutation throughout the whole range of load.

Trade Announcements.—The head office of the Efandem Co., Ltd., is now situate at Fallings Park Works, Wolverhampton. Mr. W. J. Fahn has ceased to take an active part in the conduct of the business, and Mr. Walter Howcroft has resigned his offices of managing director and secretary. All orders given on behalf of the company will be signed by the secretary, Mr. Peter Smith.

Messrs. H. Field & Son, electricians, of Leeds, are giving up the business.

Liquidations.—British Diesel Motor Vessel Co., Ltd.—This company is winding up voluntarily.

Eureka Patent Gas Engine Starter Co., Ltd.—A meeting of creditors is to be held at the office of the liquidator, Mr. T. Forster, 1, Cathedral Gates, Manchester, on December 15th.

Maxim Lamp Works, Ltd.—A petition, presented by A. Hurst and Co., Holborn, for winding up this company, is to be heard on December 14th.

Felgate Installation Co., Ltd.—A meeting is called for January 8th, at 51, Market Place, Reading, to hear an account of the winding up from the liquidator, Mr. A. G. West.

Bankruptcy Proceedings.—J. Swainson, electrical contractor, C/M and Manchester.—Supplementary dividend of 1¾d. in the £, payable Dec. 17th, at 27, Brazennose Street, Manchester.

For Sale.—The Tramways Committee of the Leeds Corporation invites tenders for six Lancashire boilers, fitted with mechanical stokers, superheaters, &c. Particulars are given in our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Accrington.—Rating Appeal.—An appeal is to be made against the assessment for income-tax purposes of the Corporation's electricity undertaking.

Argentina.—A joint stock company has just been formed in Trelew, capital of the territory of Chubut, for the supply of electric light and power to the town and district. All of the capital has been found locally, and the board comprises prominent business men of Trelew.—*Review of the River Plate.*

Barrow.—The T.C. has authorised the payment of £38 to members of the staff for overtime worked during the quarter ended September 30th. In order to meet the difficulties arising through depletion of staffs, the Electricity Committee will meet every two months instead of monthly.

Bath.—Mains Extension.—The Electric Lighting Committee has recommended that a new feeder be laid at a cost of £1,400 to supply a local works with additional power.

Belfast.—The Police Committee of the Corporation reported that the public electric lamps were being put out of commission and replaced by gas, the object being to relieve the pressure on the power station.

The Electricity Committee reported that the claim against the insurance companies in connection with the fire at the power station had been settled for £3,808.

In view of the small margin of plant available consumers have been asked to reduce their lighting as far as possible between the hours of 4 and 5.30 p.m.

The Treasury has refused the application for sanction to capital expenditure amounting to £6,700 for mains.—*Northern Whig.*

Bredbury and Romiley.—The Stockport T.C. has asked Bredbury for consent to its proposed application for an order under Sec. 6 of the Electric Lighting Act, 1909, but the D.C. has declined to agree.

Burton-upon-Trent. — Proposed Loan.— The Electricity Committee's report regarding the heavy demand upon the present cables, and recommending the laying of new cables, has been referred to the Finance Committee, which recommends the Council to make application to the L.G.B. for sanction to a loan of £3,500 for carrying out the work.

Canada.—Niagara Falls Proposal.—Another scheme to further develop Niagara water power has been brought forward by the Hon. P. A. Porter. This proposes to dam the gorge three-quarters of a mile south of Queenstown, about 6 miles below the Falls, which would submerge the Whirlpool and lower rapids below a long narrow lake. The drop of the river from the Falls to Lewiston, 7 miles below, is about 100 ft., providing, according to the estimate, 2,000,000 H.P. The scheme also includes a ship canal and locks to connect Lakes Ontario and Erie, and, on the Canadian side, a canal and locks connecting to the Welland Canal. Mr. Porter estimates the cost of the scheme at about $100,000,000.

Clayton.—Prov. Order.—The Electrical Distribution of Yorkshire, Ltd., has intimated to the U.D.C. its inability to proceed with its application for a provisional order, owing to the refusal of the B. of T. to sanction such orders until the end of the war.

Dartford.—Proposed Loan.—The Electric Lighting Committee proposes to apply for sanction to borrow £600 for mains required in connection with the Council's housing scheme.

Eastbourne.—The Electricity Committee has received an application from the London Electric Firm for terms for a supply of electricity should they remove their works to the town; the estimated requirements are 24,000 units a year.

East Ham.—Price Increase.—The Electricity Committee having reconsidered the suggested increase of 10 per cent. on the charges for current supplied to private consumers and to the tramways undertaking, now recommends that, in view of the decreased consumption, together with the extra cost of generation and materials, the charges for electricity be increased as follows:—Private consumers, by 10 per cent.; tramway supply, by 5 per cent., the increases to take effect in respect of current supplied during the March, 1916, quarter; the question of the charges for public lighting was deferred until a subsequent meeting. The Committee's recommendation was adopted.—*Stratford Express.*

Ewell and Worcester Park.—Prov. Order.—The application of the South Metropolitan Electric Tramways and Lighting Co. for a prov. order for E.L. has been deferred until after the war.

Fakenham.—E.L. Scheme.—The Walsingham R.D.C. has been informed that the promoters for the E.L. scheme at Fakenham had intimated that they were prepared to pay any reasonable expenses to the Council, and the clerk was instructed to draft an agreement with the company for submission to counsel and the Fakenham P.C.

Finchley.—Owing to a breakdown at the Council's electricity works, the supply of electricity was interrupted from 3 p.m. on Sunday till 8 a.m. on Monday morning, and the streets in the Council's area were in complete darkness. Owing to the failure occurring on a Sunday, many residents were unable to obtain other means of lighting.

Hastings.—Proposed Loan.—The T.C. has applied to the L.G.B. for a loan of £500 for house services.

Harrogate.—The Corporation electricity department has issued an interesting booklet on the subject of "Electricity Supply for Residences," which deals particularly with the operation and possibilities of the rateable value tariff of 15 per cent. of the rateable value plus ½d. per unit, and the supplementary contract tariff for water-heating apparatus having 100 per cent. load factor and automatic control, of ½d. per unit. Data relating to a house rented at £60 per annum is given, in which case, owing to the electrical labour-saving improvements introduced, one servant was easily dispensed with, and a considerable annual saving resulted. The pamphlet discusses the use of electric fires with automatic temperature control; briefly refers to the electric iron—not less than the 600-watt iron, with wall socket, being recommended for heavy household work; vacuum cleaners and hot-water service.

Hornsey.—Loan Sanction.—The L.G.B. has sanctioned the raising of a further £500 in connection with a loan of £6,000 for supply mains.

Hythe. — Street Lighting. — The Sub-Committee appointed to consider the question of the charges for public lighting by the Folkestone Electric Light Co., reported that the charges for normal lighting were £850 per annum, but having regard to all the circumstances the company would accept £425 if all public lamps were extinguished, and in the event of the lighting being resumed the charges would be *pro rata*. The offer had been ratified by the directors of the company, and the Committee recommended its adoption as a fair and reasonable settlement.

London. — Marylebone. — Arrangements have been completed for linking up the Council's electricity undertaking with that of the Central Electric Supply Co.

The B.C. recently applied for sanction to borrow £5,450 for mains and house services; as a result of negotiation with the L.C.C. the application has been amended to £3,800. The Finance Committee has recommended that a sum of £5,156 be advanced out of general fund account as a temporary loan to the electricity department for the hiring of apparatus to consumers.

Manchester. — Excess Profits. — The Corporation Parliamentary Sub-Committee had before it a tabular statement showing the computed profits of various municipal departments. In the electricity department, the computed profits for purpose of excess profits duty were put at £163,210 in 1914, and £169,553 in 1915, the average of the best two pre-war trade years was placed at £159,308, and the profit in respect of the year 1915 £10,245. In the tramway department the computed profits are £165,496 in 1914, £106,549 in 1915, the average of best two pre-war trade years is £160,293, and the loss in respect of 1915 £53,744. The Committee adopted a resolution expressing the opinion that enterprises owned and carried on by municipal authorities should be excluded from the operation of the excess profits duty clauses of the Finance Bill. If that is considered undesirable then it is alternatively suggested that the several undertakings of a municipal Corporation should be consolidated and treated as one trade or business, the excess profit duty being charged on the total profits after deducting the total losses.

Restricted Lighting.—The Watch Committee has been notified by the Home Office, in reply to its petition for the withdrawal of the order for restricted lighting owing to the number of fatal accidents, that the question of amending the order is under consideration, and probably the new order will apply from two hours after sunset instead of one hour as at present.

New Zealand.—The Gisborne B.C. has decided to submit the following loan proposals to the ratepayers:—For electric light and power, £10,000; for the tramway service, £30,000.—*Otago Witness.*

Newquay.—Price Increase.—On December 3rd a B. of T. inquiry was held relative to the application of the Newquay Electric Light Co. to increase its maximum charge from 6d. to 8d. per unit. After discussion, it was agreed that the maximum price to private consumers should be 7d. per unit, the price not to exceed 6d. per unit after the expiration of one year after the conclusion of peace, but with liberty to the company at the expiration of this period to refer the question of a higher price than 6d. to arbitration by the B. of T.

Padstow.—Street Lighting.—The U.D.C. has accepted the offer of the Electric Supply Co. of a rebate of £4 on the original charge of £39 for public lighting for the half-year, owing to suspension of lighting.

Plymouth. — Three Months' Working. — The electrical engineer's quarterly return of the working of the electricity undertaking to the end of September, shows that on the Prince Rock section 712,466 units were sold, producing an estimated revenue of £6,524, as compared with 640,917 units and £6,119 in the corresponding period of last year. On Newport Street section 612,825 units were sold, producing £4,935, as against 564,185 units and £4,338 received last year. At the end of September there were a total of 2,929 consumers connected to the mains.—*Western Morning News.*

Queensbury.—Prov. Order.—The Electrical Distribution of Yorkshire, Ltd., has notified the Council that the company's application for a prov. order must be deferred until after the war, and if the Council was favourable to the proposal the company was prepared to proceed with the necessary preliminary work. The present Council is in favour of the proposals, and expressed a hope that the company would renew its application on the termination of the war.

South Shields.—The electrical engineer, Mr. H. S. Ellis, reports that the authorities have agreed to a certain amount of very much reduced lighting in the streets. This consists of two 20-C.P. lamps on each arc lamp standard, and one 20-C.P. lamp on each ordinary standard, the lamps being dipped in green paint and the surrounding globes coloured black, in such a way as to leave only one-third of the bottom part of the lantern transparent. Owing to the restricted lighting the output for lighting purposes is down very considerably, and, owing to shortage of labour, the output for traction purposes shows a falling off of 10 per cent. for November as against October; the power output has increased about 20 per cent. for the year up to date, which to some extent compensates for the serious loss in revenue for lighting purposes.

Sheffield.—Financial Estimates.—The general manager of the electricity undertaking has submitted a statement of estimated income and expenditure on revenue account for the years ending March 25th, 1916 and 1917. The total working expenses for the 12 months ending 1916 are estimated at £165,889 (as against the manager's original estimate of £87,308), and for the following year at £217,103. Against these figures is reckoned an anticipated income of £277,450 for 1916 (original estimate of £199,240) and £337,650 for 1917, thus leaving a gross profit of £101,561 for 1916 (original estimate £111,932) and £120,527 for 1917. After allowing for interest, the estimated profit is put £65,490 for 1916 (original estimate £61,086) and £61,270 for 1917. From this has to be deducted the sinking fund charges estimated at £53,069 (original estimate £56,834) and £54,919, so that there remains an anticipated surplus of £12,421 for 1916, and £6,351 for 1917. The surplus for 1917 is based upon the main contract for coal at Neepsend being placed at a favourable price. If the present day prices obtain, the financial result is likely to show an adverse balance. Mains are to be extended in various parts of the city at an approximate cost of £2,395.

Southampton.—The Electricity Committee has decided not to purchase, at the present time, any additional motors for hire purposes. The electrical engineer reported on the delay in the deliveries of coal, and the Committee has decided to obtain alternative tenders for three and six months' supplies. The Committee has decided to have a defective boiler and furnace at the electricity works put into working order as soon as practicable, and directed the electrical engineer to report twice in each year as to the condition of all the machinery and mains.

St. Annes.—In order to minimise risk of a failure of supply of electrical energy such as was recently experienced, the D.C. has approved a proposal for obtaining a second-hand boiler.

Stockport.—With reference to the application of the Cheadle and Gatley U.D.C. for a supply of current to that district, the T.C. has decided to offer the supply on the same terms and conditions as those offered to the Bredbury and Romiley U.D.C.

Sutton.—Bulk Supply.—The South Metropolitan Electric Tramways and Lighting Co. has this week commenced taking a bulk supply of current from London, the mains having been laid and transforming gear installed at the Sutton power station, pending the dismantling of the present steam plant.

Swansea.—A Wayleave Difficulty.—The Electric Lighting Committee recently reported that the work in connection with the supply of electricity to certain works was being held up owing to the question of payment for wayleave, &c. The Council had expended £4,000 in the purchase of cable which was lying idle. The Midland Railway Co. and the Rhondda and Swansea Railway had granted free wayleaves, the Duke of Beaufort was only charging a nominal amount of 5s. per annum, while the owner of a canal over which it was necessary to carry a cable originally asked £10 a year, which had been reduced to £1 per annum during the continuation of the war, after which a fresh agreement would be necessary on one month's notice. It was pointed out that the value of land was much enhanced by a supply of electricity. It was decided that the town clerk should wait on the owner of the canal and obtain, if possible, better terms.

Tasmania.—According to the *Australian Mining Standard*, the chief engineer of the Government hydro-electric department, Mr. J. H. Butters, recently reported that there was no reason why the Great Lake electric supply scheme should not be available for use in January next, provided certain small items were delivered. Apparently the pipe lines are complete, and the power station machinery being erected; the transmission line work is proceeding rapidly, while work at Hobart is well in hand. The Government passed a resolution to purchase the Hobart Gas Co.'s electrical undertaking for £108,000, it being represented that the hydro-electric business would suffer if the present agreement for a minimum bulk payment of £5,000 a year by the company to the Government were allowed to remain in force.

Tarporley.—The U.D.C. has granted Messrs. Cluetts permission to erect overhead lines for the purpose of installing the electric light at the Parish Church.

Tonbridge.—New Cooking Tariff.—The U.D.C. has decided to alter the tariff for current for heating and cooking to 1d. per unit with a minimum consumption of 8s. per quarter, plus the usual meter rent. The previous charge was 2d. per unit.

Wanstead.—Prov. Order.—The U.D.C. has received an intimation from the County of London Electric Supply Co. that it is not at present proceeding with the application for a prov. order for E.L. in the Council's district.

Weymouth.—Loan Sanction.—The T.C. has received the sanction of the L.G.B. to the borrowing of £1,020 for mains (repayable in 15 years), and £910 for services (repayable in 25 years). On account of the abnormal conditions now prevailing, the Council has decided to make for the period of the war a meter charge of 2s. 6d. per quarter as from December 31st next.

Wimbledon.—The T.C. at its meeting on November 1st instructed the town clerk to open up negotiations with the Fixed Price Light Co. with a view to terminating the agreement of August, 1912. The town clerk reported that Messrs. Handcock and Dykes, consulting engineers to the Fixed Price Light Co., had intimated that their clients were prepared to treat provided they could be satisfied that the Council had the power to purchase the Fixed Price Light undertaking in Wimbledon, and could make payment in fulfilment of any understanding that might be arrived at without proviso or reservation; that their clients would in the meantime consider the basis on which they would terminate the agreement and asking for any early reply, as in the event of the agreement not being terminated by mutual consent, conditions will render it necessary for them to raise the price of electricity to their consumers. The Committee has informed Messrs. Handcock and Dykes that the Council is not prepared to extend the period of the agreement, and further asked for payment of outstanding accounts. The application for a prov. order for the supply of electricity to the parish of Cuddington has been deferred.

York.—Year's Working.—The annual accounts of the electricity undertaking show that the income from private lighting was £23,987; from public lighting, £2,756; from power supplied to the Tramways Committee, £6,021; rents of motors, &c., amounted to £1,034, making a total of £33,798. The total working expenditure was £18,702, including £462 for war allowances, leaving £15,096 to be transferred to the net revenue account; after payment of interest and sinking fund charges amounting to £12,549 and income-tax of £281, there was a surplus of £2,265, which has been transferred to the reserve and renewals account.

TRAMWAY and RAILWAY NOTES.

Australia.—A recent issue of the *Commonwealth Engineer* described the progress made in connection with the Victorian Railways Newport power house, which will supply the Melbourne Electric Railways. The 36-acre site of this station is about 200 yards distant from the Yarra River, the ground being covered with basaltic rock, which has been used for concrete work in the foundations. The main building, measuring 310 ft. long and 415 ft. wide, is built with steel pillars and reinforced plaster walls; the transformer and switch houses are of brick. The concrete (cement, sand and water) has been applied to the walls by a compressed air apparatus which projects the mortar into the required position. The first section of the power plant, consisting of six 10,000-kw. Parsons turbo-alternators and exciters, is being erected. Current will be generated at 3,300 volts and stepped up to 20,000 volts for distribution to the sub-stations. A wet air cooling plant is being installed, also two 350-kw. auxiliary turbines and a test pond for 12,500-kw. capacity, together with special arrangements to facilitate the testing of any steam-electrical set. Some nine miles of cables for auxiliary plant are led through cement conduits in the foundations. An electrically-driven 60-ton crane, with a five-ton auxiliary hoist, is provided in the engine-room. The assembling of the first 12 Babcock boilers and Green economisers has been practically completed; the complete equipment will consist of 24 boilers each evaporating 30,000 lb. of water per hour, working at 210 lb. pressure and supplying steam superheated to 600° F. The boilers are erected in pairs, each pair with a 75-ft. steel chimney and fan equipment. Mechanical coal conveying and suction ash plants are being provided, the former for supplying bunkers over the boilers and adjoining coal stores. The condensing water is obtained from and returned to Hobson's Bay, and a pair of rotary screens is provided in each inlet conduit.

The Government Bill providing for the temporary control of the Melbourne tramways, after they have been taken over by the Government from the Melbourne Tramway and Omnibus Co., provides for a Board, contisting of five members, appointed by the Governor in Council; the Board is to have power to borrow up to £500,000 by way of overdraft or debentures, to provide for the running of the tramways. A tramway fund is to be created, and all moneys received by the Board are to be paid into the fund, except certain amounts which will be required to meet working expenses. The Board will be appointed as soon as the Bill is enacted, and will remain in office until October 31st, 1917, or until such date earlier as the Governor in Council may determine on.—*Melbourne Age.*

Belfast.—According to figures supplied by the general manager, the effect of providing a 20-minute service on certain Corporation tramway routes which formerly had a 10-minute service, has been a weekly net loss of £80. The 10-minute service is to be restored.

Bradford.—Recently Mr. C. J. Spencer, the Corporation tramway manager, reported on the question of adopting a system whereby the collection of fares by conductors would be avoided, the suggestion being that tickets should be purchased in advance, the proposal having a bearing upon the employment of women conductors. He considered the suggested system unworkable, and likely to result in the employment of a larger instead of a smaller staff. Mr. Spencer states that he is attracted by the idea of volunteer labour as employed at Birmingham, and considers it would be desirable to consider it for future use; he also suggested that a certain number of women conductors should be employed on certain routes as an experiment.

The Committee decided to defer the question of employing women until it had seen the result of an appeal for men of between 40 and 50 years of age, and also that the recommendations of the manager with regard to volunteers be adopted.

Blackpool.—Tramway Accident.—A collision occurred on the Corporation tramways, close to the central station, on December 2nd, when the town was enveloped in a heavy fog. Both cars were damaged, and two or three passengers complained of shock, while a lady conductor had a fortunate escape from serious injury.

Colchester.—Female Conductors.—The T.C. has decided to have 10 females instructed with a view to their employment as conductors on the electric tramcars.

Continental.—Italy.—The Consiglio Superiore dei Lavori Pubblici has approved of the scheme for the electrification of the whole of the Sangritana line. The kilometre subsidy has been increased to 10,000 lire for kilometre for 50 years.

The Sindaco of Verona has been authorised to invite tenders for carrying out the construction of the Valpantena electric tramway, which is to be worked by the syndic.

Two weeks' experimental running of four electric goods trains on the Bardonecchia-Modane trunk line, including the Frégus tunnel, have given most satisfactory results, and, in consequence, the goods service in and out of Italy will be forthwith established. The passenger service on the same section, hitherto in operation between Bussoleno and Bardonecchia, will shortly be extended to Modane.

Derby.—Female Conductors.—The T.C. has decided to employ women conductors, owing to the scarcity of male labour.

Keighley.—Extensions.—The T.C. has applied for an extension of time until August 7th, 1917, for the completion of the overhead equipment for electrically-propelled vehicles from the tramway terminus at Ingrow to Oxenhope.

L. & Y. Railway Electrification.—To supply energy to the last electrified section of the L. & Y. Co., *i.e.*, from Manchester to Bury, *viâ* Heaton Park, and for future lines which it is understood will be converted to electrical working, a power station has been built a few miles out of the city. The initial plant consists of two 5,000-kw. 6,600-volt turbo-alterators, by Messrs. Dick, Kerr & Co., which will supply three-phase current to two sub-stations at Victoria Station, Manchester, and at Radcliffe; also a third turbine unit consisting of a 500-kw. three-phase 25-cycle Westinghouse geared turbine set, to generate current at 440 volts, for auxiliary uses.

The main switchgear has been supplied by the British Thomson-Houston Co. Three 1,000-kw. Dick, Kerr rotary converters with transformers are installed in each sub-station for supplying the trains which, as pointed out in a short article on the special form of conductor rail used, which appeared on page 315, will be supplied with direct current at 1,200 volts pressure. The train equipments are also by Messrs. Dick, Kerr, and each motor coach will be equipped with four 200-h.p. motors.

Newcastle.—Traffic Difficulties.—The City Council, on Wednesday last week, considered a resolution that the Tramways Committee be instructed to arrange that the last car shall leave the City Terminus at 10.30 on each week day, and 9.30 on Sundays. An amendment that the Committee be instructed to reconsider the matter, with a view to giving further travelling facilities, was carried. Mr. R. Mayne, chairman of the Tramways Committee, said the Tramways Committee was conscious of the inconvenience caused, but it was carrying 50,000 more workmen per week. It had the offer of 120 volunteers, and if it had the offer of 240, who could be properly trained, a modified service could be given at night. The difficulty was to get men who could train during the day. He thought there were many men in the city whose occupation would enable them to give their services during the day—insurance agents and ministers of the Gospel. Under the present system the outward bound cars leave the city about 9 o'clock.

Sheffield.—Tramway Estimates, &c.—Owing to the severe strain on the motormen and conductors, in consequence of the heavy traffic at Christmas, the City Council is recommended to authorise the Committee, if it deem it advisable, to suspend the tramway service altogether on Sunday, the 26th inst. It is anticipated that the working of the tramways for the years ending March 25th, 1916 and 1917, will show net balances of £34,974 and £23,635 respectively. These figures are subject to any adjustment which may be necessary in respect of the "Excess Profits" tax.

Stockport.—The T.C. has approved a recommendation of the Tramway Committee, that with a view to inducing more regular attendance to duty a gratuity of 2s. per week be paid to all motormen, conductors and inspectors who work a complete week in accordance with the duty sheets of the department, pending the return of the members of the department now with the Forces.

TELEGRAPH and TELEPHONE NOTES.

Hull.—The Corporation Telephones Committee has agreed to grant female operators a bonus of 1s. 6d. per week, no previous provision having been made for female employés. As regard the male staff, the Committee has agreed to recommend the Council to adopt the Post Office scale of bonuses, 3s. to those in receipt of less than £2, and 2s. to those receiving between £2 and £3 weekly.

Japan.—Hitherto no private person has been permitted to establish or work any apparatus for wireless telegraphy in Japan. According to a new regulation, however, which came into force on November 1st last, radio-telegraphy may, subject to a licence being first obtained, be installed for private administration outside the State telegraph and telephone area, in vessels and in aircraft. A licence may also be obtained by persons who conduct experiments in wireless telegraphy.

Leyton.—With a view to economy, the Establishment Committee of the U.D.C. is considering the desirability of establishing a central telephone switchboard with extensions.

Russia.—The Minister of the Interior has applied to the Council of Ministers for an allocation of 350,000 roubles, to construct a fourth telephone line between Petrograd and Moscow.

Wireless Telephony. — It is announced from Christiania that Mr. Frost, the Norwegian manager of the radio-station at Stavangar, has devised a new apparatus for wireless telephony, and has associated himself with the Marconi Co. in the matter. At present further experiments are being made with the apparatus at the English Marconi station to ascertain the reliability of the system.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Adelaide.—January 19th. P.M.G. Common-battery switchboard. See "Official Notices" November 19th.*

January 26th. Deputy P.M.G. Twenty tons of galvanised-iron wire, 400 lb. to the mile.*

Brisbane.—P.M.G. January 26th.—Galvanised-iron wire. January 5th.—Jointing sleeves and copper-clad steel wire. See "Official Notices" November 19th.

January 26th. Deputy P.M.G. Telephone instruments, parts and accessories.*

Sydney.—January 31st. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

Melbourne.—January 4th. P.M.G. Electric measuring instruments, telephone parts, and automatic common-battery telephones.*

Beckenham.—December 12th. U.D.C. 2,000 tons of Midland slack coal (100 tons per week from January 1st, 1916), for the Electricity Department. See "Official Notices" December 3rd.

Brighton.—December 14th. Electrical fittings, for the B. of G. Mr. Horace Burfield, Clerk, Parochial Offices, Prince's Street, Brighton.

London.—West Ham.—December 16th. Three months' supply of electrical fittings, for the B. of G. Forms of tender from Mr. T. Smith, Clerk, Union Road, Leytonstone, N.E.

Nuneaton.—December 24th. Corporation. Supply and erection of an overhead line, for the Electricity Department. See "Official Notices" to-day.

Redditch.—December 28th. Council. Eighty tons per week, for three months, of D S. nuts or rough slack. See "Official Notices" to-day.

Reigate.—December 15th. Lubricating oil for six or twelve months, for the Corporation electricity works, suitable for Diesel engines and air compressors. Particulars from the Electrical Engineer.

South Africa.—Durban.—January 5th. Corporation Telephone Department. (1) Telephone apparatus and materials; (2) underground cables; (3) 540 c.i. pipes, 9 ft. long, for cables. Messrs. Webster Steel & Co., 5, East India Avenue, E.C., are the Corporation's London agents.*

Spain.—January 26th. Construction and installation in the Cadiz Naval Arsenal of an electric power plant. Conditions, &c., from the Negociado Quinto de la Segunda Seccion (Material) del Estado Mayor Central de la Armada, Ministerio de Marina, Madrid. Deposit £800. Local representation.—*Board of Trade Journal.*

January 28th. Sixty years' electric tramway concession, Monte del Pardo district, Madrid. Direccion General de Obras Publicas, Ministerio de Fomento, Madrid.

Walthamstow.—December 15th. U.D.C. Supply of low-tension cable, for the Electricity Department. See "Official Notices" December 3rd.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Dartford.—The following orders for coal have been placed:—

John Waddell & Co.—800 tons Yorkshire Main, at 25s. 6d. per ton.
Cleeves & Co.—500 tons Yorkshire slack, at 24s. 2d. per ton.
Wallace, Spiers & Co.—One truck of Yorkshire "Thurcroft," at 23s. 7d. per ton.

Grimsby.—The Public Lighting Committee has accepted the tender of Messrs. W. Lucy & Co., Ltd., to supply, for a period of two years, house service boxes at an approximate cost of £260, and house fuse boxes at an approximate cost of £201; also the tender of Messrs. Ed. Bannister & Co., Ltd., to supply up to 200 tons of Brodsworth nutty slack, at 15s. 7d. per ton.

Middleton.—The E C. has accepted the tender of Messrs. Spurrier, Glazebrook & Co. for cylinder and engine oils, and that of Mr. R. Taylor for extensions required at the electricity station boiler house.

Sheffield.—The City Council has accepted the tender of Messrs. Thos. A. Ashton, Ltd., at £215, for electric light fittings at the King Edward VII Hospital.

Southampton.—The Electricity Committee has received the following tenders for the purchase of 450 yards of 1-in. high-tension concentric lead-covered paper-insulated cable and 800 yards of ·025 cable:—

		450 yds. 1·00 lead-covered cable.	800 yds. ·025 cable.
B.I. & Helsby Cables, Ltd.	(accepted)	£121	£91
Mackintosh Cable Co., Ltd.	.. ..	133	94
Pirelli-General Cable Works, Ltd.	..	129	103
W. T. Henley's Tel. Works Co., Ltd.	..	124	98

The following tenders have been accepted by the Tramways Committee for the supply of a motor-generator:—

		Generator and motor.	Switchboard.
Lancashire Dynamo Co. ..	(accepted)	£181	£100
British Westinghouse Co. (not to specification)		202	128
Phœnix Dynamo Co., Ltd		211	141

Also the tender of Thermit, Ltd., for welding 140 tram rail joints, at 25s. per joint.

Stockport.—The Corporation Hospitals Committee has accepted the tender of Messrs. McClure & Whitfield, for wiring for the laundry and electric irons.

The Tramways Committee has accepted tenders of the following firms for stores:—Messrs. Dick, Kerr & Co., Ltd., H. Hollingdrake and Son, B.T.H. Co., Ltd., Baxendale & Co., Wilkinson, Heywood and Clarke, the Liverpool Jute Bag Co., Spicer Bros., Ltd., Rostron Bros., McClure & Whitfield, Brecknell, Munro & Rogers, and the Brush Electrical Engineering Co.

Weymouth.—The T.C. has accepted the tender of Mr. Bryer Ash for 300 tons of stock coal for the electricity works, at £1 3s. 4d. per ton; and that of the Direct Coal Supply Co., of Yeovil, for 250 tons of best Admiralty smokeless coal.

FORTHCOMING EVENTS.

University College, London.—Friday, December 10th. At 5 p.m. Lecture on "Domestic Electric Heating," by Prof. A. H. Barker.
Friday, December 17th. At 5 p.m. Sixth lecture on "Electric Heating and Electric Furnaces," by Prof. J. A. Fleming, F.R.S.

Greenock Electrical Society.—Friday, December 10th. At 7.45 p.m. At Temperance Institute, 19, West Stewart Street. Paper on "Electric Tramways," by Mr. J. Punch.
Friday, December 17th. At 7.45 p.m. Special Open Meeting.

North of England Institute of Mining and Mechanical Engineers.—Saturday, December 11th. At 2 p.m. At Neville Hall, Newcastle. General Meeting.

Royal Society of Arts.—Monday, December 13th. At 4.30 p.m. At John Street, Adelphi. Cantor Lecture, on "Optical Glass" (Lecture III), by Dr. W. Rosenhain, F.R.S.

Illuminating Engineering Society.—Tuesday, December 14th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "Recent Developments in Electric Incandescent Lamps in Relation to Illuminating Engineering," by Prof. J. T. Morris.

Post Office Telephone and Telegraph Society of London.—Tuesday, December 14th. At 6.30 p.m. At the I.E.E., Victoria Embankment, W. C. Fifteen-minute papers on "Supervision as seen from Below" by Mr. S. A. Coase; "Phonograms," by Mr. B. R. Mead; "The Deficit on the Telegraphs," by Mr. W. H. F. Webb.

Association of Supervising Electricians.—Tuesday, December 14th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Electric Lifts," by Mr. H. Marryat.

Institution of Civil Engineers.—Tuesday, December 14th. At 5.30 p.m. At Great George Street, Westminster, S.W. James Forrest Lecture on "Electrical Railways," by Mr. H. M. Hobart, to be read by Mr. J. A. F. Aspinall; also Special General Meeting.

Nottingham Society of Engineers.—Wednesday, December 15th. At 7.30 p.m. At the Welbeck Hotel, Milton Street. Paper on "The Evolution of High-Speed Steel," by Mr. A. W. Shepherd.

Institution of Electrical Engineers.—Thursday, December 16th. At 8 p.m. At Victoria Embankment, W.C. Paper on "The Design of High-Pressure Distribution Systems," by Mr. J. R. Beard.

(**Western Local Section**).—Monday, December 13th. At 5 p.m. In the Old Library of the South Wales Institute of Engineers, Park Place, Cardiff. Paper on "The Design of High-Pressure Distribution Systems," by Mr. J. R. Beard. After the meeting there will be an informal dinner.

(**Manchester Local Section**).—Tuesday, December 14th. At 7.30 p.m. At the Engineers' Club. Paper on "The Design of High-Pressure Distribution Systems," by Mr. J. R. Beard.

(**Scottish Local Section.**)—Tuesday, December 14th. At 8 p.m. At Princes Street Station Hotel, Edinburgh. Paper on "Electric Heating: Its Present Position and Future Development," by Mr. G. Wilkinson.

(**Birmingham Local Section**).—Wednesday, December 15th. At 7 p.m. At the University, Edmund Street. Paper on "Notes on the Ignition of Explosive Gas Mixtures by Electric Sparks," by Mr. J. D. Morgan.

(**Students' Section**).—Wednesday, December 15th. At 7.45 p.m. At the I.E.E., Victoria Embankment, W.C. Paper on "The Aluminium Electrolytic Arrester with an Introduction on Electrical Disturbances," by Mr. A. G. Ramsey.

Institution of Mechanical Engineers.—Friday, December 17th. At 6 p.m. At 11, Great George Street, Westminster, S.W. Paper on "Engineering Colleges and the War," by Dr. R. M. Walmsley and Mr. C. E. Larard.

Electro-Harmonic Society.—Friday, December 17th. At 8 p.m. At Holborn Restaurant. Smoking Concert.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, December 17th. At 7.30 p.m. At Bolbec Hall, Newcastle. General Meeting.

Manchester Association of Engineers.—Saturday, December 18th. At Grand Hotel, Aytoun Street, Manchester. Topical Discussion Evening.

NOTES.

Electrical Engineer Recruits.—As we go to press we learn that the London Electrical Engineers (Headquarters 46 Regency Street, S.W.) are now open for recruiting again.

Electricians and Instrument Repairers Wanted.—There is a great and urgent need for the above for the Royal Engineers Wireless Section. We would draw the attention of suitably qualified men wishing to enlist for the period of the war to a notice appearing among our official advertisements to-day.

Fire Caution.—The British Fire Prevention Committee has issued a special Christmas "Fire Warning," free, for the public use in connection with public and private Christmas entertainments, &c. Electricity users are warned not to make the slightest change in electric wiring without consulting a competent electrician or an electrical inspector. Copies of the "Warning" are obtainable from the Committee, upon written application with the necessary return postage enclosed.

Nitrogen Fixation in Russia.—It is reported in Scandinavian papers that a large company with strong capital backing has been formed in Russia for the purpose of manufacturing nitrates from the nitrogen of the air. The process to be used is the well-known Birkeland and Eyde process. All arrangements with the Norwegian company, owners of the Birkeland and Eyde patents, have been made and a plant is being built in the North of European Russia, off the White Sea.—*Metallurgical and Chemical Engineering.*

Electric Heating and Electric Furnaces.—In his fifth lecture at University College, London, last week, Prof. J. A. Fleming dealt with the products of the electric furnace—carborundum, graphite, aluminium, calcium carbide, quartz glass, and the ferro-alloys being the principal substances. The enormous industry that has grown up at Niagara, in connection with the supply of cheap electric power that is available there, was described, after which some views of the aluminium works at Lochleven, in Scotland, were given. A great advantage of the smelting of aluminium from bauxite was shown to be the continuity of the process, which is carried on day and night, the raw materials being added and the molten metal tapped off without interrupting the process.

The quartz glass which is now so widely used, and is of constantly increasing importance, is prepared electrically; in the perfectly transparent forms the air bubbles, said the lecturer, are eliminated by heating the material in an electric furnace under a pressure of 500 lb. per sq. in. The importance of the ferro alloys dates from the discovery of the remarkable effects of small percentages of manganese, tungsten, vanadium, nickel and molybdenum on the dynamic qualities of steel. While 0·6 per cent. of vanadium raises the tensile strength of steel only from 36,300 lb. per sq. in. (ordinary carbon steel) to 45,620 lb., it increases the resistance to shock enormously—vanadium steel standing 12,776 shocks, whilst carbon steel endured only 4,200. Most of the "special steels" are made in electric furnaces. Such minute percentages cannot be directly mixed with the charge, so they are introduced in the form of alloys with iron.

The lecture concluded with a brief account and demonstration of electric welding.

Appointments Vacant.—Switchboard attendant for Lancaster (27s. 6d.); electricians and instrument repairers for the Wireless Section, R.E. See our advertisement pages to-day.

Electric Propulsion of Battleships.—The following abstract of a paper read by Mr. W. L. R. Emmet, before the American Society of Naval Architects and Marine Engineers, appeared in a recent issue of *Shipbuilding and Shipping Record*:—The Navy Department of the United States has awarded to the General Electric Co., of Schenectady, N.Y., a contract for electric propelling machinery for the new battleship *California*, which is being built at the New York Navy Yard. This ship is of the largest and most powerful class which has been adopted by the United States. Her displacement is 32,000 tons, and her maximum speed is to be about 22 knots, requiring about 37,000 S.H.P. The contract with the General Electric Co. covers two turbine-driven generating units, four propelling motors (one for each shaft), switching apparatus, cables, instruments, &c., two turbine-driven exciting units, and a complete equipment of condensing auxiliaries and ventilating blowers, all driven by motors from the exciting units. In fact, it covers practically the entire engine room equipment except the main condensers.

Each of the auxiliary units is of 300 KW. capacity with a 240-volt direct-current generator geared to a high speed, non-condensing turbine. These turbines will exhaust into the heaters or into the main turbines, or both.

The motors which drive the auxiliaries will be designed for a considerable range of speed variation, so that the auxiliaries will be adaptable to economical conditions at different speeds of the ship.

The award of this contract was the result of a very long campaign conducted by the writer in which the equipment of the collier *Jupiter* has been an incident.

The *Jupiter* has now been in commission for two years and has proved an unqualified success. The steam consumption of the main drive with 190 lb. pressure, dry steam, and 28·5 in. vacuum is 11 lb. per H.P.-hour delivered to the propeller shafts, which is at least 30 per cent. better than is done by reciprocating engines in ships of the class. There is also evidence of further saving in the *Jupiter*, incident to the fact that her large slow-speed propellers are turned with a perfectly uniform angular motion and with entire freedom from racing, conditions heretofore unknown with such propellers.

The generators for the *California* are bipolar alternators, and the motors are arranged to be connected either for 24 poles or 36 poles. For economic cruising at 15 knots or less, one generator will be used with motors on 36-pole connection. For higher speeds the 24-pole connection will be used. The ship will be capable of operating at a speed of about 18·5 knots with one generator.

Speed variation with either motor connection will be effected by change of turbine speeds through the agency of variable speed governors designed to hold automatically any desired speed within usual ranges. This arrangement, which is also used in the *Jupiter*, entirely prevents racing and makes it convenient to hold a fixed speed irrespective of variations in sea, weather or steam conditions. It is thought that this feature will be valuable in fleet formations.

The steam consumption guaranteed on the *California* covers the total steam required for the main turbines and engine-room auxiliaries as described above. The conditions are 250 lb. gauge pressure, dry steam, with such vacuum as can be produced under trial conditions. The guaranteed water rates per horse-power delivered by the propeller shafts are as follow:—At 10 knots, 14·6 lb.; at 15 knots, 11·4 lb.; at 19 knots, 11·1 lb.; maximum speeds, 11·9 lb.

Very heavy penalties are imposed in case these guaranteed consumptions are exceeded in trials, $25,000 per lb. for the two lower speeds and $20,000 per lb. for the two upper speeds.

At full speed the *California* propellers will make 175 R.P.M., this being about the lowest speed of propellers which is practicable within the space. The propeller speeds proposed for the sister ships with Parsons turbine drive is 240 R.P.M., and comparisons by Dyson's method indicate that this speed difference will give the *California* an advantage of about 9 per cent. in propeller efficiency.

The following table gives a comparison of steam consumption per effective horse-power between the *California* as guaranteed, the *Florida* and *Utah* which are driven by Parsons turbines, and the *Delaware*, which is driven by recipocating engines. These figures are taken from the published records of trials:—

	12 kts.	15 kts.	19 kts.	21 kts.	Prop. speed. 21 kts.
Florida ...	31·8	—	24·0	23·0	328
Utah ...	28·7	—	20·3	21·0	323
Delaware ...	22·0	—	18·7	21·0	122
California ...	17·3	15·2	15·0	16·4	175

Such a table as this affords the truest basis of comparison of prime movers in ships.

The estimated weight of the propelling machinery without condensing auxiliaries is 530 tons, and that of the turbines originally proposed was 653 tons.

Comparing the arrangement of the machinery of the *California* with the *Utah*, and a geared turbine equipment for a large warship shown in a paper by Sir Charles Parsons read in March of 1913, Mr. Emmet drew attention to the simplicity of piping, steam and vacuum connections with the electric drive as compared with the other methods. The *California* has two turbines, the *Utah* has 10, and the proposed Parsons geared equipment has 32.

All of the steam passages between turbines in these arrangements involve loss of useful pressure, and many of them involve risk of vacuum loss through air leakage, for it must be remembered that ships are often subject to vibration and that there may be appreciable relative motion of these different parts through expansion strains or working of the ship, or through their own inertia when the ship is vibrating or labouring in a seaway.

The Gas Turbine.—Messrs. Brown Boveri, of Baden, Switzerland, have for some time been experimenting with a view to producing a commercially practical gas turbine, designed apparently on the impulse principle. According to *Industrial Engineering* there is a group of bottle-shaped explosion chambers arranged radially around the shaft of this turbine. Each chamber has inlet valves for air and gas and an exhaust valve for the products of combustion. The operation bears points of resemblance to a two-cycle gas engine, and may be described in general as follows:—Air is forced into each explosion chamber in turn. The gas entry valves are then successively opened and gas is also forced in under pressure. When volatile liquid fuel is used, a spraying apparatus worked by compressed air, on similar lines to the Diesel engine, is resorted to. As the explosion chambers become filled with the predetermined proportions of gas and air, the mixture in each is fired by electric sparks. The exhaust valve in the neck of the explosion chamber is then opened and the hot gases rush out through a conical nozzle similar to that used in the two best known types of impulse steam turbines.

From the nozzle the now cooling and expanding gases impinge on the rotor. A fan keyed on the shaft is placed at the exhaust end to assist in drawing the hot gases through the rotor and accelerate the reduction of temperature. When the pressure in the explosion chamber has been spent an independent blast of air is forced through to perform the office of scavenging, as in the two-cycle reciprocating gas engine after the completion of the power stroke. In the case of the turbine, however, the time available for scavenging is longer. A fresh supply of fuel is next forced into the explosion chamber and the process continues. The exhaust gases can also be used to raise steam in a small boiler, the steam being used to drive the air and gas pumps, and also for the producer.

A gas turbine would occupy only one-third of the space required for a gas engine of equal power, and would average not more than a quarter of the weight.

A "Boots" Electric.—The well-known firm of wholesale and retail chemists, Messrs. Boots, whose headquarters are at Nottingham, have recently added another electric vehicle to their fleet, being the fourth in two months. The lorry, which we illustrate, is of the "Cedes" Electric Traction Co.'s make, the two rear wheels being fitted with slow-speed motors built into the hubs The lorry is a large one, being 21 ft. 6 in. long, and 7 ft. 6 in

wide, and has a carrying capacity of 4 tons. Messrs. Boots are already using a three-wheel electric car built by Messrs. Thouvenin-Tollin, of Paris, an industrial truck of the Silvertown Co.'s make, a similar vehicle supplied by the General Vehicle Co., and two Napier electric chassis converted to commercial delivery vans, and several other electric vehicles are being added. We understand that the firm's experience with the electric vehicle has been extremely satisfactory.

Admiralty Board of Invention and Research.—The Board has appointed a number of permanent sub-committees to work in conjunction with the Central Committee, of which Lord Fisher is president. Submarines, mines, searchlights, torpedo-nets (not in ships), wireless telegraphy, and generale lectrical and electro-magnetic subjects are covered by a single sub-committee, forming Section II, and composed of the Duke of Buccleuch, Prof. W. H. Bragg, Mr. W. Duddell, Prof. Sir E. Rutherford, Dr. R. T. Glazebrook, and Mr. C. H. Merz.

Controlled Establishments.—The total number of controlled establishments is now 2,026. The staff of the Ministry of Munitions already numbers 3,000, and, according to Dr. Addison, it is growing daily. A list of 200 persons who are giving gratuitous services to the Minister of Munitions is published in the *Times* for Tuesday last. It contains the names of many scientific experts, employers of labour, and business men who are assisting. Among them the following appear:—Sir John Aird, Prof. H. B. Baker, Dr. G. T. Beilby, Mr. S. Z. de Ferranti, Mr. W. Duddell, Sir R. A. Hadfield, Prof. J. S. Haldane, Mr. Alfred Herbert, Prof. B. Hopkinson, Sir A. B. W. Kennedy, Mr. Michael Longridge, Mr. W. T. MacLellan, Mr. S. S. Moore-Ede, Sir H. Norman, M.P., Sir B. Redwood, Mr. J. Swinburne, and Prof. Sir J. J. Thomson.

Educational.—Portsmouth Royal Dockyard School.—On Wednesday, December 1st, Rear-Admiral A. W. Waymouth, supported by the Dockyard officers, distributed the prizes to the engineering, electrical and shipwright apprentices, under instruction in H.M. Dockyard School at Portsmouth.

The annual report included the following remarkable summary of successes gained during the year by students of the school:—

Two Whitworth Scholarships out of four offered for open competition in Great Britain (Messrs. J. E. Wright and W. E. Park).

Nine Whitworth Exhibitions out of a total of 30 offered.

Four Royal Scholarships out of the five offered in mechanics for open competition in the United Kingdom.

Two Admiralty Prizes out of four competed for by apprentices in all the Royal Dockyards.

One Student Cadetship in Naval Construction and a number of Military Cadetships to the Woolwich Military Academy.

These excellent results should establish the position of the Portsmouth Dockyard School amongst the technical schools of the country.

Royal Technical College, Glasgow.—The annual report states that eight members of the Governing Body, 37 of the staff, and 1,774 students (past and present) joined the Colours; 91 have lost their lives, and nine have gained distinction. The facilities possessed by the College for the testing of materials have been freely placed at the disposal of the Government, and have been utilised by several sections of the War Office and the Admiralty, hundreds of tests having been carried out.

Institution and Lecture Notes.—Royal Institution.—The following are the lecture arrangements at the Royal Institution, before Easter:—Prof. H. H. Turner, a course of six illustrated lectures, adapted to a Juvenile Auditory, on "Wireless Messages from the Stars": How the Messages are Carried, December 28th; How the Messages are Received, December 30th; First Message, January 1st; Second Message, January 4th; Third Message, January 6th; Fourth Message, January 8th. Prof. W. A. Bone, three lectures on "Utilisation of Energy from Coal." Prof. Henry E. Armstrong, two lectures on "Organic Chemistry in War." Prof. Sir J. J. Thomson, six lectures on "Radiation from Atoms and Electrons." The Friday evening meetings will commence on January 21st, when Prof. Sir James Dewar will deliver a discourse on "Problems in Capillarity." Succeeding discourses will be given by Prof. E. G. Coker, Prof. S. P. Thompson, Prof. Sir J. J. Thomson, and others.

Association of Mining Electrical Engineers.—A meeting of this Association will be held in the Grosvenor Hotel, Deansgate, Manchester, on Saturday, December 18th, when a paper by Messrs. Izod and Rouillard, entitled "Centrifugal Pumping Plant of the Roodepoort Deep, Ltd.," will be read and discussed.

A coal-cutting demonstration took place on Saturday, at Bredisholm Colliery, near Glasgow, under the auspices of the West of Scotland Branch of the Association. A series of similar demonstrations will be held throughout the country, and the promoters are endeavouring to arrange that a different type of coal-cutter shall be explained on each occasion. Mr. Robert Rae, of Messrs. Anderson & Boyes, Motherwell, gave an interesting demonstration, the machine used being one of the latest type manufactured by his firm. Upwards of 150 managers and machinemen from all parts of Lanarkshire were in attendance.

Institution of Electrical Engineers.—The Institution has been in correspondence with the Local Government Board with with regard to the periods sanctioned by the Board for the repayment of municipal loans, seeking to obtain extensions of these in respect of cables, conduits, storage batteries, and reinforced concrete. The Board has agreed to extend the period for conduits from 25 to 30 years, and for storage batteries from 5 to 7 years, but declined to receive a deputation on the subject.

The Council has made application, in the name of the Institution to the Research Advisory Council appointed by the Board of Education, for grants in aid of the researches which the Research Committee has in hand or has decided upon. The Council has approved a report of the Research and Wiring Rules Committees urging the desirability of carrying out an investigation into the mechanical and physical properties of rubber considered as an insulating material, and included it in the list furnished to the Research Advisory Council.

At the meeting of the Yorkshire Local Section on Wednesday last, Prof. A. B. Field read his paper on "Some Difficulties of Design of High-Speed Generators."

Foreign Trade.—Figures for November.—The following are the electrical and machinery figures given in the official returns for November:—

	Month of October.		*Inc. or dec.*	*Eleven months, 1915.*		*Inc. or dec.*
Imports.						
Electrical goods and apparatus, excluding machinery and uninsulated wire	£ 131,334	+	£ 68,509	£ 984,231	−	£ 167,786
Machinery ...	752,664	+	335,300	8,147,036	+	1,986,883
Exports.						
Electrical goods and apparatus, excluding machinery and uninsulated wire	406,910	+	169,967	2,922,017	+	88,687
Machinery ...	1,602,563	−	137,070	17,717,897	−	12,161,040

Fatalities.—An adjourned inquest was concluded at Wallsend, on November 30th, relative to the death of James Nicholson, electrician, who was killed on November 19th by an explosion on board a vessel at Messrs. Swan, Hunter & Wigham Richardson's Shipyard.—John Lauder, fitter's labourer, stated that deceased and his mates were engaged on electric wires when there was a loud explosion and a flash of blue flame. Four men were injured, Nicholson was killed, and another man had since died.—John George Oliver, foreman electrical engineer, said that from his inspection of the scene of the explosion, he could find nothing to account for it. He had instructed one of the men to charge the battery, but gave no special instructions. Replying to the Coroner, witness said that if there had been no ventilation, or even defective ventilation in the place, that would accelerate the explosion. Questioned by Mr. F. E. Footer, who appeared for the Electrical Trade Union: Dibbage, the man he instructed to charge the battery, had no previous experience of the accumulator, which was a new type to the works. Frederick Whiteside, chargeman of fitters, said the ventilation fan was running at 830 revs. per minute. John Hamilton Paterson, analytical chemist at the works, said the question of the ventilators did not affect the cause of the explosion. Medical evidence attributed death to shock. The jury returned a verdict accordingly, and added that, in their opinion, the explosion was caused by a spark.

John Douglas, a Sheffield fitter, while working on a scaffold, on Saturday morning, at Stoke Works, grasped a live electric wire, and was killed.

A Manchester coroner's jury inquired on Monday into the death of Frank Southern (21), a mechanics' labourer, who had been employed by the British Westinghouse Co., Trafford Park. On Friday last week he was working near a vertical boring mill which revolved at the rate of one revolution per minute. Another man who was inside a large casting on the mill called out to Southern in order to inform him that he might ease the boring tool. Southern, however, without waiting to receive the message, put his head through a vent hole and was caught by the boring tool, his head being smashed to pulp. It was stated at the inquiry that the deceased had previously been cautioned not to get his head where there was any danger of injury, and it was surmised that he had forgotten the instruction. H.M. Factory Inspector Seal said that about 8,000 people were employed by the firm, and there had only been five fatalities in three years—an excellent record, having regard to the nature of the work conducted. A case such as the one now being investigated, added the inspector, was due to what might be called unpreventable causes so far as the employers were concerned, and he could not suggest anything likely to prevent any similar accident in future. A verdict of "Accidental death" was returned, and Sir Wm. Cobbett, who appeared for the Westinghouse Co., expressed sympathy with the relatives of the deceased.

A Cardiff paper states that Norman Price, Ystradmynach, employed at the Penallta Colliery, was killed on December 1st, by coming in contact with a live wire. It appears that Price hung his lamp on a live wire, while he attended to a tram that had left the rails.

Patents and Alien Enemies.—The Board of Trade has granted licences to Mr. J. J. Armfield and to Messrs. Gilbert Gilkes & Co., Ltd., in respect of patent No. 22,565/12, granted to Honold; and to the Lilleshall Co., Ltd., in respect of patent No. 409/13 granted to the M.A.N. Akt. Ges.

Volunteer Notes.—Engineering Institutions' Volunteer Engineer Corps.—Orders for Week commencing December 13th, 1915.—By Lieut.-Col. C. B. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, December 13th.—Sections 1 and 2, Technical; Sections 3 and 4, Squad, Signalling Section and Recruits.

Tuesday, December 14th.—School of Arms with Architects Corps, 6 to 8 p.m.

Thursday, December 16th.—Sections 3 and 4, Shooting.

Friday, December 17th.—Sections 3 and 4, Technical; Sections 1 and 2, Squad, Signalling Section and Recruits.

Saturday, December 18th.—Uniform parade. Time and place to be posted at Headquarters later.

Sunday, December 19th.—Trench digging for Sections 1 and 2. Parade at Victoria Station—time to be announced later.

Sections for Technical Parade at Headquarters, London Electrical Engineers, 46, Regency Street, S.W.

Sections for Shooting Parade at Miniature Ranges.

Unless otherwise ordered, all Parades at Chester House.

E. G. Fleming,

Company Commander and Acting Adjutant.

Patents in War Time.—In a letter to the *Morning Post*, recently, Mr. H. Fairbrother pointed out the necessity of legislation for the extension of the term of a patent, the manufacture of which is stopped by the necessary requisition of works for the manufacture of munitions. At present there is no provision or compensation for a firm making a patented article. They are entirely stopped from doing so by this cause, and all the time the life of the patent is running on. "What of the firm making a patented machine under a minimum licence, or the patentee from whom the last, and perhaps only remunerative, part of his rights is taken? He must pay the annual patent taxes, and gets nothing for it."

Inquiry.—The makers of the "Arkless" fuse are asked for.

Protecting Bright Articles from Rust.—In the *American Machinist*, Mr. A. L. Haas remarks that the ease with which bright surfaces of steel or iron will tarnish is one of the vexations of the machine builder. Machines and other goods for export are often subject to tropical temperatures before reaching their destination; the temperature may be sufficiently high to melt grease, and the atmosphere such that rust will easily form. Under such conditions special care is necessary.

The low melting-point of many greases and the subsequent troubles incident to complaints from oversea destinations have led some shippers to revert to the old white-lead and tallow coating. This is mixed with 4 lb. of tallow to 1 lb. of white lead, the latter being stirred into the melted tallow. Because of the acid in the tallow this coating must be removed at the earliest opportunity, using kerosene or turpentine; but there is no doubt that it protects from rust.

The question of protective coatings against corrosion is most difficult in the case of quantities of small-size articles. It is difficult to slush them effectively; to pack in solid grease is out of the question; simple oiling is insufficient, and to apply lacquer by hand is prohibitive on cheap goods.

A method which has been giving first-rate results in the case of buckles, rings and harness fittings generally may help to solve this vexed question elsewhere. Cheap varnish is diluted to two or three times its volume with methylated spirits. On account of evaporation, the mixture is made up as required.

The apparatus consists of two oil drums, each minus one end. An ordinary 5-gallon drum, which is 11 in. in diameter, has ½-in. holes punched in the bottom and sides. The other drum may be of 6¾-gallon capacity, of 12 in. diameter, or a 10-gallon drum, which is larger still.

The larger vessel is filled about one-quarter full, and the articles to be treated are put in the smaller vessel. The perforated drum is lowered into the liquid, immersing the articles to be coated. Withdrawing the smaller vessel immediately, the major portion of the fluid drains back again in a minute or so. To finish draining and to harden the coating, the contents are then shot out on a wire draining surface and in 15 min. are ready to pack.

The process is really a cheap and effective form of cold lacquering in bulk. The articles remain bright for long periods of time, while the coating is not in the least obvious—in fact, it can hardly be detected—so that the appearance of the goods is not altered. Articles so treated will stand a long sea voyage, arriving at their destination in perfect condition, and will then keep free from rust for 12 months.

The quantity of bright buckles 5 gallons of the mixture will cover has to be seen to be believed. Hundreds of gross can be treated daily by the addition of ½ to 1 gallon per day. An effective draining bed can be procured in the shape of a wire mattress. An inclined pan beneath it, with a draining hole at one corner, completes the apparatus.

Compensation Case.—At Southport County Court on Tuesday, Judge Thomas gave his sanction to an agreement under which the Lancashire and Yorkshire Railway Co. undertook to pay £100 to Percival Hingley, of Walton, as compensation for an accident he received while in their employ. It was stated that Hingley was a wireman, and while engaged in his duties at the Formby power station he was severely burned about the body, face and arms. He was in hospital for about 16 weeks, and was still receiving treatment. The railway company had offered him a position as stores issuer, but he had refused this on the ground that it would be a bar to advancement. He was able to use his right arm, but his left arm and hand were permanently stiff. In agreeing to the settlement, Judge Thomas said the company had made a fair offer.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—Mr. E. J. FOSTER has been appointed draughtsman at the West Bromwich Corporation electricity works.

During the absence of the Borough Electrical Engineer of Accrington (Mr. HAROLD GRAY), who is serving with Accrington and Burnley Howitzer Brigade, the Acting-Engineer is to be paid an extra remuneration of £100 per annum from the date of Mr. Gray's enlistment.

During the absence of Mr. T. K. RICHARDSON on sick leave, the Marylebone B.C. has appointed Mr. LEONARD, the chief station assistant, to carry out the duties, and has temporarily increased his salary to £350 per annum.

The Bermondsey Electricity Committee, in reporting the resignation of Mr. W. TANCRED, first engineer-in-charge, states that Mr. Tancred is a most efficient officer, and while at any time it would be sorry to lose his services, at the present time his resignation means a very great loss. Mr. Tancred's name is included with those of a number of the clerical staff who have asked for permission to enlist in the Army under Lord Derby's scheme. The Committee recommends the Council to refuse the permission asked for, and to request the Ministry of Munitions to exempt the staff from military service.

General.—In the Civil Service appointments, published in the *London Gazette*, we note that Mr. H. D. T. WALDRAM has been appointed by the Admiralty to be electrical station supervisor at H.M. Dockyards and Naval Establishments. Mr. WM. MCCLELLAND and Mr. JAMES MCCAFFERY have been appointed electrical engineers in H.M. Naval Establishments.

Mr. Alderman SMITH, J.P., has been re-elected chairman of the Barrow Corporation Electricity Committee, which office he has held since its formation.

Colonel A. SINCLAIR has been re-elected chairman, and Alderman GEO. COLWILL vice-chairman, of the Swansea Electric Lighting and Tramways Committee.

Sergeant W. C. D. MILES, of the Willesden staff of the British Thomson-Houston Co., and formerly of the Rugby staff, has received a commission in the Westminster Dragoons. He has been in the Army since the outbreak of war.

Mr. E. MURRAY PAUL, electrician at the Central G.P.O. Telephones, has joined the Wireless Section of the Royal Flying Corps, and is stationed in Ireland.

Councillors EVANS and STEMBRIDGE have been appointed chairman and deputy-chairman respectively of the Sheffield Corporation Electric Supply Committee.

Mr. E. F. CLARKE has been appointed temporary consulting and advisory engineer to the Sutton Coldfield T.C. electricity department at a fixed fee or salary of £125 per annum. Objection was raised to the appointment of Mr. Clarke, as he is a member of the Council, but it was stated that he had done wonderfully good work for the Council for a long time for nothing, and that the present temporary appointment would mean a saving running into three figures annually.

Mr. SAMUEL LUSTGARTEN, of Monkseaton, electrical engineer, a natural-born British subject, has changed his name to Langton.

Roll of Honour.—Private JACK MURPHY, of the Irish Guards, has been killed in action in France. He was formerly employed in the overhead department of the South Lancashire Tramways Co.

The Imperial College of Science and Technology has issued a list of past and present students and staff who are serving with the Forces. The information, which is corrected down to May 27th, 1915, is alphabetically arranged, and states the college, session or grade, rank, and regiment. An analysis shows that there are 715 officers and 470 men, making a grand total of 1,185.

Lance-Corporal TOWLER, of the 6th South Staffordshire Regiment, who was prior to enlistment on the electrical staff of the Sunbeam Motor Car Co., Ltd., of Wolverhampton, has died of wounds received in action.

Second-Lieutenant H. J. G. DAVISON, who was killed at the Dardanelles on June 4th, aged 28 years, was an electrical engineer, being an old Faraday House man.

Obituary.—MR. C. J. WOLLASTON.—We regret to record the death, at the age of 95 years, of Mr. Charles James Wollaston, which occurred on November 27th at Burnham, Somerset. The *Times* describes the deceased gentleman as "an interesting link with the earliest days of submarine telegraphy," and says that he was "a member of the small company to which was transferred the concession granted by Louis Napoleon for laying a telegraph line under the English Channel." "He was one of the engineers in charge of the operations on the *Goliath*, which started on Wednesday, August 28th, 1850, from Dover to lay the line thence to Cape Grisnez." That cable soon ceased to work, but another concession was obtained from Louis Napoleon for permanent communication, which was to be established by October 31st, 1851. "To work this concession the Submarine Telegraph Co. was formed, and a real cable, containing four copper wires, was manufactured for the purpose at Wapping. Each of the wires was encased in a covering of gutta-percha ¼ in. thick, and the whole was protected by a layer of hemp yarn saturated with pitch and tallow, and by an outside covering of galvanised iron wires. The electrical testing of this cable, which weighed about 200 tons, was carried out by Mr. Wollaston, who was also on the Government vessel *Blazer*, by which it was laid. This vessel, having the cable coiled in its hold, reached the South Foreland early on the morning of September 25th, 1851, and, after landing the shore end, started across the Channel. Communication with the shore was maintained continuously. . . . Mr. Wollaston received a Civil List pension in March, 1900, in recognition of his services in the introduction of submarine telegraphy."

EUGEN HARTMANN.—The *E.T.Z.* announces the death of Eugen Hartmann, one of the founders of the firm of Hartmann & Braun, of Frankfort, at the age of 62.

PROF. FRANCIS RICHARD BARRELL.—The *Times* records the death of Prof. Francis Richard Barrell, Professor of Mathematics at Bristol University, which occurred suddenly while he was lecturing. He was 55 years of age, and among the books of which he was the author was one on "Electricity and Magnetism."

Mr. Thomas Parker.—We deeply regret to record the death, at the age of 72 years, of Mr. Thomas Parker, J.P., M.I.C.E., M.I.E.E., M.I.M.E., F.R.S.E., which occurred on Sunday last, after a long illness, at his residence at Ironbridge, his native village, in Shropshire. During the last few years Mr. Parker has been less prominently associated with the electrical world than was his wont in the earlier parts of his career, when his activities in electrical manufacturing and tramway and railway electrification work placed him in the front rank of the electrical industry. As a small boy he showed a strong inclination for mechanics, and he began practical work at a very early age. It is stated that in the early eighties of last century he discovered the action of nitric acid in facilitating the formation of the oxide in secondary batteries, and his patent rights in this connection, taken out in conjunction with Mr. Elwell, formed the subject of litigation, in which the rival claims of these two gentlemen and M. Gaston Planté were considered, the Court dividing the patent rights between the parties. Planté's interests were taken over by the Elwell-Parker electrical manufacturing firm, which began business about this time in Wolverhampton. Mr. Parker was intimately concerned with the manufacture of the plant and equipment for the Blackpool conduit tramway system, and the Electric Construction Corporation, Ltd., which subsequently took over the Elwell-Parker interests, equipped the first section of the Liverpool Overhead Railway. Other electric traction installations with which he was closely identified included the South Staffordshire Tramways, and his lighting installation work included the Oxford system. His connection with the Electric Construction Corporation ceased in 1894, and he formed the business of T. Parker, Ltd., which subsequently was transferred to the Rees-Roturbo Co. Latterly he has not been actively connected with any of these industrial concerns, but has devoted his attention to consulting practice, and one piece of work which passed through his hands was the electrification of the first section of the Metropolitan Railway about ten or twelve years ago. He was interested also in "Coalite." He once took an active interest in politics and stood unsuccessfully as a candidate in the Liberal interests.

Will.—Mr. H. Steel, of Steel, Peech & Tozer, Sheffield, left £652,418 gross and £645,273 net personalty.

NEW COMPANIES REGISTERED.

Fredk. R. Butt and Co., Ltd. (142,314).—This company was registered on December 4th, with a capital of £7,500 in £1 shares, to take over the business carried on by H. F. Bigge, F. R. Butt, J. H. Webb, and P. C. Kent, at 147, Wardour Street, W., and elsewhere, as Fredk. R. Butt & Co., and to carry on the business of scientific and general electrical engineers, manufacturers of X-ray, therapeutic, medical, electro-medical, wireless telegraph, and telephone and other instruments and apparatus, and equipment for operating theatres, surgeries, and hospitals, constructors of radio-telegraph and radio-telephone stations, etc. The subscribers (with one share each) are: H. F. Bigge, Penybryn, Copperkins Lane, Chesham Bois, electrical engineer; F. R. Butt, 164, Downham Road, Canonbury, N., electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are H. F. Bigge and F. R. Butt, both permanent. H. F. Bigge is the first managing director. Registered office: 147, Wardour Street, W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Sterling Telephone and Electric Co., Ltd.—Mortgage, dated November 11th, 1915, to secure £48,253 17s. 1d. charged on the company's undertaking and property, present and future, including uncalled capital and freehold land at Dagenham, Essex.

Rawlings Bros., Ltd.—Issue on November 19th, 1915, of £1,100 debentures, part of a series of which particulars have already been filed.

Barraclough Brothers, Ltd.—Particulars of £1,000 debentures, created July 27th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Jarrow and District Electric Traction Co., Ltd.—A memorandum of satisfaction to the extent of £200 on October 1st, 1915, of debentures created August 3rd, 1910, securing £20,000, has been filed.

Carville Site and Power Co., Ltd.—Issue on November 27th, 1915, of £10,000 debentures, part of a series of which particulars have already been filed.

Northampton Electric Light and Power Co., Ltd.—Particulars of £40,000 second debentures, created October 15th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £16,100. Property charged: The company's undertaking and property, present and future, including uncalled capital, subject to first debenture stock. No trustees.

A memorandum of satisfaction in full on November 11th, 1915, of two debentures dated January 13th and January 30th, 1911, securing respectively £500 and all moneys due for the time being to the Northamptonshire Union Bank, Ltd., has been filed.

Rhondda Tramways Co., Ltd.—A memorandum of satisfaction to the extent of £4,000 of charges dated March 24th, 1911, November 13th, 1912, and March 11th, 1915, securing £250,000 has been filed.

CITY NOTES.

French Electrical Companies.

The Société Electro-Métallurgique Française de Forges suffered severely from the influence exercised by the war. The gross profits declined from £613,000 in 1913-14 to £359,000 in 1914-15, and the net profits from £202,000 to £64,000, while the dividend has receded from £2 16s. to £1 4s. per share on an ordinary share capital of £600,000.

The Société d'Electricité de Paris, which has an ordinary share capital of £1,000,000, has only now proceeded to distribute the dividend for the year which closed on June 30th, 1914. At the general meeting held in January, 1915, the rate of distribution was fixed at 16s. per share on the ordinary capital, and £1 6s. 8d. per share on the deferred shares, less income-tax. This works out at 15s. 4d. on registered shares, 13s. 10d. on bearer shares, and 22s. 3d. on the deferred shares.

The Compagnie Parisienne de l'Air Comprimé reports net profits of £63,000 for the year ended with June 30th, 1915, as contrasted with £187,000 in the preceding year. The diminution, which had been foreseen, is attributed to the fact that the electrical department did not yield any results, whilst the influences of the war caused a considerable restriction in the consumption of compressed air, the production of which was also rendered more expensive owing to the advance in the prices of coal. It is proposed to pay a dividend of £1 4s. per share, as compared with £1 16s. per share in 1913-14.

The Société Générale des Nitrures, which was formed by French aluminium producing companies two or three years ago, reports that the company's investigations in 1914-15 were hampered by the war. Arising from experimental and installation work the company realised a gross surplus of £32,000, as compared with £81,000 in the preceding year, and net profits of £5,800, as against £32,000, on a share capital of £136,000. Four new patents had been applied for, and the investigations regarding a new method of manufacture had been successful. It is added that the Norwegian Nitrate Co. had fully responded to expectations.

The accounts of the *Compagnie Française des Câbles Télégraphiques, of Paris*, which has a share capital of £540,000, show that the receipts from the cable traffic in 1914 amounted to £355,000, as compared with £261,000 in the previous year, the increase being principally due to the growth in the Atlantic messages with America since the outbreak of the war. An augmentation also took place under the heading of various receipts, namely, from £28,000 in 1913 to £33,000 last year, chiefly owing to the participation in the United States and Hayti Telegraph & Cable Co. The share of the French Government in the working results of the Paris company was £51,000, of which slightly over one-half referred to the free transmission of official telegrams. The net profits amounted to £91,000, which permits of the payment of a dividend at the rate of 4 per cent., as against 2.4 per cent. in 1913. Out of the balance of £64,000 then remaining, two-thirds have been applied according to the convention with the State to writing down the internal guarantee and advances made by the State, and the other third has been placed to the contingency fund.

Cordoba Light, Power & Traction Co., Ltd.—The report for the year ended September 30th shows that the profit, after meeting all charges, is £19,035, and with £26,321 brought in, the total is £45,356. It has been customary, hitherto, to pay half-yearly dividends on the preference shares on February 1st and August 1st. In future the dividend period will correspond with the financial year of the company. A dividend at the rate of 6 per cent. (less tax) has already been paid on the preference shares for the half-year to January 31st, absorbing £8,150. To give effect to the alteration in the dividend period the directors now recommend the payment of a dividend at the rate of 6 per cent. per annum (less tax) on the preference shares for the eight months to September 30th, requiring £10,625, and £26,581 is carried forward. The period covered by the accounts was one of great depression in the Argentine, from which there was some recovery during the latter part of the year. Arrangements were concluded recently, with the consent of the Treasury, for the issue, on December 1st, of £500,000 6 per cent. promissory notes. This has permitted of the replacement of the notes which matured on that date and the repayment of other obligations of the company.—*Financial News.*

New Russian Electrical Companies.—The Elektrichestve Co., of Vyaznikach, began operation on October 1st/14th, 1915. The offices of the company are in the town of Vyaznikach, in the Government of Vladimir.

The Russian Co. "Elektrovod" is being formed with a capital of 500,000 roubles to exploit the electric station, waterworks and mills of the united villages near St. Enakaievo.

Automatic Telephone Manufacturing Co., Ltd.—The preference share and transfer books will be closed from 17th to 24th inst. for the purpose of preparing the dividend warrants on the 6 per cent. preference shares for the half-year ending 31st inst.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—The *Times* states that the directors have now decided to pay the interim dividend of 2½ per cent. on the ordinary shares which was postponed in July last.

Electrical Securities Trust, Ltd.—The report states that, after charging all expenses and interest due and accrued on debentures, amounting to £2,500, there is a loss of £710. No credit has been taken in the accounts for interests or dividends which may have accrued and which have not been paid within the period of the accounts. The directors regret that they have been unable to dispose of any of the investments held by the trust during the past year and so enable the trustees for the debenture-holders to make a further distribution.—*Financier.*

Companies Struck off the Register.—The following companies have been struck off the Register, and are accordingly dissolved:—

Auto-Electric Vacuum Drying Syndicate.
Automatic Centrifugal Pump.
Boudjah Electric Lighting Co.
East Kent Electric Supply Co.
Filaments.
Radiographic Processes.
Simplex Lifeguard & Step Co.
Small Power Dynamo & Motor Co.
Treibel Smoke Combustion Co.
United Sherardizing.

Power-Gas Corporation, Ltd.—The report for the year ended September 30th, 1915, states that the results of the company's trading during the year have been satisfactory. The business has been further developed and important contracts made. The results for the year show a total profit of £20,743, plus £7,479 brought forward. A dividend of 6 per cent. per annum is to be paid on the ordinary shares, leaving £9,105 to be carried forward.

Manx Electric Railway Co., Ltd.—The accounts for the year ended September 30th show a debit balance of revenue account of £9,436. The debenture interest, amounting to £9,000 per annum, was paid in cash for the first half-year and funded by the issue of second debentures for the second half-year.—*Financier.*

Bullers, Ltd.—For the year ended July 31st, there is a profit of £27,860, plus £7,676 brought forward. Allowance for depreciation has been made. A further dividend of 5 per cent., making 7½ per cent. for the year, on the ordinary shares, is recommended, carrying £7,000 to reserve and £9,786 forward.

Portarlington Electric Light & Power Co., Ltd.—The profit and loss account on the first year's working showed a gross profit of nearly 10 per cent. on the preference shares. The revenue was £560. The number of lamps connected was stated at 1,345.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers during the four weeks ended October 29th, 1915, have amounted to 1,889,945, compared with 1,262,426 in 1914.

Western Telegraph Co., Ltd.—The directors have declared the first quarterly interim dividend of 3s. per share, free of income-tax, for the year ending June 30th, 1916, being at the rate of 6 per cent. per annum.

Brazilian Traction, Light & Power Co., Ltd.—A quarterly dividend of 1½ per cent. on the fully-paid cumulative preference shares is announced.

Eastern Extension, Australasia & China Telegraph Co., Ltd.—An interim dividend for the quarter to September 30th of 2s. 6d. per share, free of tax, is announced.

STOCKS AND SHARES.

Tuesday Evening.

The surprising part about the Stock Exchange markets is that they should keep as firm as they do in the face of general conditions. Had there been no European War going on, general depression might well have been expected in the ordinary course of events, having regard to the near approach of the end of the year and the tempting offers of Government stocks by France, Canada, and New South Wales. Now, however, with the war very much in evidence in the Near East, Stock Exchange prices are showing a robustness and a vitality that in themselves afford the clearest possible proof that the public at large have absolute confidence in the way the war is going to terminate.

The Stock Exchange through the present year has maintained cheerfulness and courage in the face of everything. Thanks largely, of course, to the action of its clients, the public, in refusing to sell, and in being ready to buy when cheap stock came on offer, the House all along has refused to indulge in optimistic prophecies as to the probable length of the war; but at last one finds a cautious disposition to put an earlier date to the conclusion of the struggle than Lord Kitchener did, for instance, when, seventeen months ago, he roughly estimated its duration at three years.

The markets for domestic securities have fallen upon some quietude, and Home Railway stocks gave way after their spasm of firmness. The Underground group is coloured by sympathy with the rest, although, considering the very substantial rise which has taken place in the income bonds of the Underground Electric Railways, the setback has been nothing alarming so far. The £10 shares dropped back more sharply, while the shilling shares keep fairly steady. London Electric ordinary £10 shares changed hands at 29s. 4½d. today, and languid interest is taken in East London ordinary stock at about 80s.

The real feature of the electricity supply market is the way in which the preference shares of the principal companies hold their prices. This is a distinguishing characteristic of industrials as a whole. The demand is greater than the supply, and the public are content to buy industrial preferences on a 6 per cent. basis: in some cases they are being bought to yield 5½ per cent., and even less. Why this should be, when there are so many more securities returning as good dividends from what used to be regarded as higher-class stocks, it is difficult to say; but evidently the public consider that preference shares in a home industrial undertaking, the progress of which they can watch more or less for themselves, are certainly as well worth holding as any Government or railway issues.

The only signs of weakness at the moment in electricity preference shares is that in Charing Cross preference and the Company's City preference, both of which have fallen ¼. Amongst the ordinary shares, Westminsters are the same fraction lower; and the only change in the debenture stocks is a fall of 2 points in London Electric 4 per cents. As we have indicated before, there will be no surprise felt in the Stock Exchange if the leading electric lighting companies find it necessary to cut their dividends in respect of the current six months, what with the increased cost of coal, the difficulty of obtaining labour, the obscuring of London's lighting, and the higher prices which have to be paid for materials.

What news there is from Mexico is read as being of a rather more favourable character, and there is just a slight inclination to buy some of the Mexican utility bonds again. On the other hand, the market for Mexican railway stocks is dull; and while this is so, it is not to be expected that prices of the utility descriptions can make any headway worth mentioning. Brazil Tractions have a tendency to crumble, the Rio exchange operating against the market, while there is a good deal of speculation as to what dividend the company will next declare on its common shares. The public are not buying much of anything at present, but are rather conserving their bank balances—probably with a view to making a good show at the bank by the end of the year.

Rio Tramway bonds keep very firm, the Firsts being 93 and the Seconds 78¼. The Anglo-Argentine Tramway group is also steady, the 5 per cent. first debenture being wanted at 81. There is not much floating supply of it, and the absorption of two or three thousand pounds stock would have the effect of putting up the price at once. The British Columbia group shows no change, but, having regard to the way in which Canadian investments of all kinds are being taken, some kind of an upward movement in the British Columbia stocks is sufficiently likely to justify holders in retaining their securities. The company has passed through a bad time, and the recovery in Canadian industries takes time to spread to the west of the Continent, though of its ultimate coming little doubt is entertained.

The Telegraph market continues very firm, and the rises of last week have been followed by others in Eastern Extension shares, Indo-Europeans, Westerns, and Globe preference. The latter, at 10⅝, return 5⅛ per cent. on the money; and seeing that the ordinary can be bought to yield 6¼ per cent., allowance being made for the payment of the dividend free of tax, a holder of the preference might consider the advisability of selling half his shares and exchanging into the ordinary, which would materially help the yield on the shares, and with very little extra risk. The company has just declared the usual quarterly dividends on both classes of shares. New York Telephone bonds are keeping close to 101: and American descriptions as a whole show an amount of resiliency which suffices to lift quotations well above any reaction which may occasionally befall them.

In the manufacturing group, a rise of 5 points in Callenders debenture stock reflects the demand for a comparatively small amount, which, coming on a market bare of stock, had this somewhat remarkable effect. General Electric preference have risen ¼ to 9¾; and Telegraph Constructions follow the trend of shares in the cable companies. British Westinghouse preference have again improved, the high yield on the shares attracting buyers. More than usual has been doing in British Aluminium ordinary, the price rising to 23s. 6d. on dividend prospects. Castner-Kellners at 59s., ex their dividend of 2s. 4 4-5d., are a trifle easier. Victoria Falls ordinary eased off to 7s., after being better, but the preference are good at 18s., and the 5½ per cent. debentures keep very steady at 94. On these last, the interest payments are distributed free of income-tax, and every now and again the company buys bonds in the open market for cancellation purposes.

Rubber shares recovered as the price of the material hardened up to 3s. 6d. per lb. Buying started again, though on a more limited scale than was the case three weeks back. Rumour said that a German submarine had torpedoed a cargo boat with 500 tons of rubber on board, and that it was the loss of this consignment which had the effect of stiffening the price of the raw material in Mincing Lane. However that may be, the markets both for the shares and for the produce appear to be decidedly good. On the other hand, the copper group is weak and heavy. The United States have ceased buying copper shares, and there is not much disposition on this side to set a lead. The companies engaged in working other base metals are very popular just now, and shares in the concerns which produce lead, spelter, zinc, etc., are distinctly good. In the armament division there is no fresh feature of importance.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Dec. 7, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	8½	—	7 2 10
do. do. do. 4½ Pref.	4½	8½	—	6 0 0
do. do. City Pref.	4½	9½	—	6 8 7
do. 4 Deb.	4	80	—	5 0 0
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	+ ½	5 9 1
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 3
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	83	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1½	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	3½	—	6 0 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6½	—	7 13 10
do. do. do. 7 per cent. Pref.	7	6	—	5 16 8
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2½	—	6 19 0
South Metropolitan Pref.	7	1⅛	—	6 14 0
Westminster Ordinary	9	6½	—	6 18 6
do. 4½ Pref.	4½	4½	—	5 9 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	100½	—	5 19 6
do. Def.	1½	22½	—	6 11 3
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12½	+ ⅜	*6 10 6
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	128	—	*6 4 0
do. 8% Pref.	8½	66	—	5 6 0
do. 4 Deb.	4	81	—	4 19 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 9 2
do. Pref.	6	10⅜	+ ⅛	5 12 6
Gt. Northern Tel.	22	83½	—	6 11 4
Indo-European	13	48 xd	+2	6 15 4
Marconi	10	1⅞	—	5 6 8
New York Tel. 4½	4½	101	—	4 9 1
Oriental Telephone Ord.	10	1⅛	—	5 8 1
do. Pref.	6	6	—	6 17 9
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	6	+ ⅛	*7 12 5
do. Pref.	6	4⅝	—	5 9 7
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅝ xd	+ ⅛	*6 7 0
do. 4 Deb.	4	80	—	5 0 0
Home Rails.				
Central London, Ord. Assented	4	71	—	5 18 6
Metropolitan	1½	24½	— ¾	5 2 0
do. District	Nil	15	—1	Nil
Underground Electric Ordinary	Nil	33/9	— 1/16	Nil
do. do. "A"	Nil	5 9	—	Nil
do. do. Income	6	77½	—3	*8 16 8
Foreign Trams, &c.				
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	95 xd	—	5 5 0
Anglo-Arg. Trams, First Pref.	5½	4	—	6 17 6
do. 2nd Pref.	5½	3½	—	7 17 2
do. 4 Deb.	4	76	—	5 5 8
do. 4½ Deb.	4½	76	—	5 18 5
do. 5 Deb.	5	81	+1	6 4 0
Brazil Tractions	3½	56	— ½	6 5 0
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	87	—	5 3 0
British Columbia Elec. Rly. Pfce.	5	58	—	9 11 4
do. do. Preferred	—	37	—	Nil
do. do. Deferred	—	33	—	Nil
do. do. Deb.	4½	62	—	6 17 1
Mexico Trams	Nil	42	—	Nil
do. 5 per cent. Bonds	—	49	—	Nil
do. 6 per cent. Bonds	—	44	—	Nil
Mexican Light Common	Nil	30	—	Nil
do. Pref.	Nil	42	—	Nil
do. 1st Bonds	—	49	—	—
Manufacturing Companies.				
Babcock & Wilcox	14	2⅝	—	6 1 9
British Aluminium Ord.	5	23/6	+2/3	4 5 1
do. Pref.	6	18/8	—	6 9 9
British Insulated Ord.	15	10½	—	7 8 2
do. Pref.	6	5½	—	5 2 2
British Westinghouse Pref.	7½	88/6	+1/6	7 16 0
do. 4 Deb.	4	70	—	5 14 4
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	10½	—	7 2 10
do. 5 Pref.	5	4½	—	5 11 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	69/- xd	—1/-	6 16 7
Edison & Swan, £8 pd.	Nil	9/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	57	—	7 0 4
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	14/-	—	8 11 6
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9⅞	—	6 3 1
Henley	20	12½	—	*8 19 4
do. 4½ Pref.	4½	4½	—	5 0 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	5	7⅞	—	6 5 0
Telegraph Con.	20	34½	—	*8 1 0

*Allowance made for dividends being paid free of income-tax.

Excess Profits of Municipalities.—It was stated in the House of Commons on Tuesday, in reply to a question, that local authorities which made a profit on one business undertaking would be able to set this off against a loss on another undertaking owned by them.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, December 8th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a " Nitric	"	..	..
a " Oxalic	per lb.	1/2	1d. inc.
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	..	..
a Ammonia, Muriate (large crystal)	per ton	£50	..
a Bleaching powder	"	..	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£25	£2 inc.
a Copper Sulphate	"	£13 10	30/- inc.
a Lead, Nitrate	"	..	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
a Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	..	..
a " Chlorate	per lb.	1/5	½d. inc.
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	Nom.	..
a Shellac	per cwt.	65/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	"	£11 10	..
a " Recovered	"	..	..
a " Lump	"	£8 10	..
a Soda, Caustic (white 70/72 %)	"	..	..
a " Chlorate	per lb.	1/4	½d. inc.
a " Crystals	per ton	45/-	..
a Sodium Bichromate, casks	per lb.	8½d.	2d. inc.
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
g Babbitt's metal ingots	"	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/1⅛ to 1/2	..
c " Tubes (solid drawn)	"	1/2⅛ to 1/2⅝	..
c " Wire, basis	"	1/2 to 1/2⅛	..
c Copper Tubes (solid drawn)	"	1/2⅛ to 1/2⅛	½d. dec.
g " Bars (best selected)	per ton	£112	..
g " Sheet	"	£112	..
g " Rod	"	£112	..
d " (Electrolytic) Bars	"	£98 10	30/- inc.
d " " Sheets	"	£116 10	30/- inc.
d " " Rods	"	£105 10	30/- inc.
d " " H.C. Wire	per lb.	1/0⅝	½d. inc.
e Ebonite Rod	"	8/-	..
f " Sheet	"	2/6	..
e German Silver Wire	"	1/10	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	2/11½	½d. dec.
i Iron Pig (Cleveland warrants)	per ton	73/-	1/6 inc.
i " Wire, galv. No. 8, P.O. qual.	"	£28	..
g Lead, English Pig	"	£23 15	5/- inc.
g Mercury	per bot.	£16 15	..
c Mica (in original cases) small	per lb.	6d. to 8/-	..
c " " " medium	"	8/6 to 6/-	..
c " " " large	"	7/6 to 14/- & up.	..
c Nickel, sheet, wire, &c.	"	Nom.	..
g Phosphor Bronze, plain castings	"	..	..
g " " rolled bars & rods	"	..	..
g " " rolled strip & sheet	"	..	..
c Platinum	per oz.	210/-	..
d Silicium Bronze Wire	per lb.	1/3	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	"	£165 to £166	10/- dec.
n " Wire, Nos. 1 to 16	per lb.	2/8	..
g White Anti-friction Metals	per ton	..	..
k Zinc, Sh's (Vieille Montagne bnd.)	"	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Peat Fuel for Russian Electric Stations.—The Zemstvos' Association has, says a Moscow communication, been engaged on numerous communal questions, including that of the use of the peat bogs of Central Russia, in order to replace coal, which is now so scarce and expensive for raising steam, particularly for central electric stations, which would bring into existence a great number of manufacturing concerns. It is maintained that the institution of such stations would immediately result in great industrial activity in the Moscow district, and make it independent of the South Russian coal and Caucasian petroleum. At present the importance of electric transmission is very pressing in view of the scarcity of coal, and the disorganised railway transport system. The institution of such concerns on a co-operative basis is, however, hindered by the lack of a special law authorising the alienation of private lands for laying electric cables and overhead lines. In connection with this question, the association is seeking to have a local application of the law ruling at Baku, with respect to the land required for laying pipe lines and such like.

ELECTRICAL ACCIDENTS IN MINES.

(*Continued from page* 711.)

Of the three non-fatal accidents, one is of interest, as it shows the casual manner in which electricity is used for purposes of temporary lighting. Apparatus for the prevention of over-winding was in course of being installed in connection with the winding engines by contractors. To obtain sufficient light under the floor of No. 1 engine house, an electric lamp was attached by means of discarded shot-firing cable to two bare terminals of a portable lamp circuit. Under the floor of No. 2 engine house the rubber-covered cable of a portable lamp circuit was split open, the wires bared, and an attachment made. When the engineers had finished the work under the floor of No. 2 engine house they moved the shot-firing cable and lamp from there to No. 1 engine house, and used it for three days until, on April 15th, about 2.30 p.m., the foreman engineer noticed smoke rising up through a trap door in the floor of the engine house. On going to the trap door he found the cable burning; one of the workmen had noticed the fire, and he, in tearing down the cable, received a shock, but the voltage of the supply being low—120—it was not fatal. The colliery electrician said he was not aware of the existence of the lamps on the shot-firing cable until after the accident, but in making such a statement he proved himself either to be not speaking the truth or to have been very negligent in not giving proper attention to the plant under his charge. He was very seriously reprimanded by his employers.

In the Northern Division there occurred one fatal accident on the surface, one non-fatal accident below ground, and three above ground. The fatal accident was entirely due to the folly of four men, and one can scarcely believe that any men could be so ignorant of the dangerous element they were playing with. We have commented before on the same sort of thing. In this case, a boiler foreman and three other men were playing practical jokes. They intended to give the horsekeeper at the colliery an electric shock, and to do so they connected the handle of the donkey pump house door to a lighting switch. The horsekeeper, however, did not go near the pump house, but the fireman did, and he received a shock which killed him. The current was alternating at 220 volts. It appeared that the men had played jokes upon each other in the same way on previous occasions, but on this occasion it was a very wet night, so the deceased man made a good connection for the current to earth.

Two other electric accidents, which fortunately caused no injury to life but which might have been serious, are also reported. One which occurred in an underground engine house serves to show the possibilities of danger which are hidden in switch boxes. Owing to a fracture of the micanite insulation upon one phase of a three-phase 2,000-volt circuit, a short-circuit was caused across the phases in a main switch controller. The switch oil was heated up to flashing point and ignited, and burst off the top of the switch box. Mr. Nelson, Electrical Inspector of Mines, after making an inquiry, reported:—

> This is an accident which, though serious anywhere, would have been more serious had it taken place inbye, instead of near the shaft bottom. There seems no reason to doubt the explanation offered by the management, namely, that the explosion was caused by vaporisation of oil due to the arc set up by a short circuit within the switch-box. The oil appears to have been of good quality, and to have had a high flash-point. The only remedy it seems possible to suggest, namely, the better ventilation of such switch-boxes, had already been applied at Murton Colliery. Though such explosions are rare, one might occur conceivably even in a ventilated box if the arc caused by a short-circuit generated gas sufficiently quickly.

Another electrical accident containing dangerous possibilities occurred as follows:—A double wire armoured 3-core cable, carrying a 500-volt alternating current, served a small pump in one of the districts. The circuit was protected near the shaft-bottom by an overload trip-switch. A deputy going along the road saw flashes from the cable, and he promptly telephoned to the shaft for the current to be cut off, and sent for the electrician. It was found on examination that the cable had been punctured with blows from a sharp tool, such as a pick. Fortunately, there was neither gas nor coal-dust about; but, at the same time, there was plenty of wood, which might have taken fire had the accident not been detected in time. Mr. Nelson, Electrical Inspector of Mines, investigated the occurrence, and reported:—

> Examination showed the cable to be punctured, apparently by blows from a sharp tool, such as a pick. The overload trip-switch, which was supposed to protect the circuit, did not act. The reason the overload trip did not act is because such protection is in no way sensitive. The leakage current has to exceed the value at which the overload trip is set to operate before the latter is called into action. That is to say, the leakage current must first exceed the working current by perhaps 100 per cent. Clearly, a leakage of any value up to this overload value might produce open sparking indefinitely with only such protection as was provided at this colliery, and, it may be added, with only such protection as is usually provided below ground in mines. The contingency of a cable damaged by a pick or a nail, or by a fall of stone, may be held to be remote, but it cannot be ignored in all cases. The remedy, however, is to provide leakage cut-out protection which is called into action immediately any portion of the current, it may be a small portion, leaves the conductors provided for it to return to the generator by some other path—for example, by the cable armouring or, more directly, *via* earth. When such a leakage occurs there is a "fault" on the circuit, and the balance which normally exists at every instant between the current which enters and that which leaves the conductors of a healthy circuit is disturbed. Leakage cut-outs are brought into action by such disturbances of balance only, and they may be set to operate with any degree of sensitiveness. If it is desired to cut off the pressure from a circuit quickly should a fault occur—for example, in the event of a fall of stone on a cable in an atmosphere charged with coal-dust—the advantage which a leakage cut-out confers over an overload cut-out is at once clear. There can be no doubt that the protection of circuits below ground by this leakage method will become established practice in the near future.

In the York and Midland Division there were four fatal and nine non-fatal accidents. Of the fatal accidents, two occurred below ground and two on the surface, whilst four of the non-fatal accidents were below ground and five above ground. With reference to those which occurred on the surface, in one, a tipper working at the screens, was killed by an electric shock sustained by touching a bare place in a lighting cable which was, by mischance, at 500 volts above earth potential. The deceased was in charge of a "tippler," his duty being to tip the contents of the pit-tubs brought by an inclined creeper from the pit shaft, on to a band conveyor. Not far from the tippler there was an opening like a doorway, 5 ft. 9½ in. high, through which the tubs delivered the coal, and under the lintel of this opening passed three ordinary lighting wires, 14 gauge, rubber-insulated, tape-wound and braided. When standing at this point deceased cried out, and he was then seen to have hold by his left hand of one of the wires, which investigation showed to be bare for a space of about three-quarters of an inch. In this way he received the electric shock which caused his death.

The lamps on the circuit were 110-volt lamps, but the circuit was supplied by current from a 500-volt three-phase system, one wire of the circuit being connected to one of the phases of that system, and the other to a tapping taken from the transformer supplying the 500-volt current (which originated from an 11,000-500 volt transformer). The pressure between the line or phase to which the lamps were connected and the point in the transformer winding at which the tapping was taken was 110 volts. In this way the circuit, though nominally at 110 volts, was in

reality a 500-volt circuit, as an earth on either of two phases would cause the lamp circuit to assume a pressure 500 volts above earth. After the accident it was found that one of the phases of the system, other than that supplying the lamps, was faulty, there being an earth in a small meter-transformer in the sub-station. In all probability the deceased received a 500-volt electric shock.

The above facts were brought out at the inquest, which was attended both by Mr. Nelson, H.M. Electrical Inspector of Mines, and Mr. Frazer, junior Inspector, and at the conclusion of the evidence, and following a suggestion of the Coroner, Mr. Nelson made the following recommendations:—

1. That the lamp circuit in which the accident occurred, and which it appeared that it had not been the duty of any particular individual to attend to, should have some man appointed definitely to maintain it.

2. That only low pressure should be used for lighting. (Since the accident properly transformed current of 110 volts, that is, without the possibility of any higher pressure being attained, has been used.)

3. That some means should be provided of indicating any defects in the insulation of the 500-volt surface system and of every system.

To these suggestions the management undertook to attend.

In the other case, a greaser got killed at the bye-product coke oven stamp. The motor and gearing driving the stamp were mounted on a travelling platform moving on rails about 10 ft. from the floor level. The main switch was mounted on the wall of the building and below the travelling platform; at a height convenient for the operator there was a controller. Three-phase current at 500 volts was supplied through the switch to overhead bare wires, and from these wires rubbing contacts supplied the motor. It was the duty of deceased to oil the machinery on the platform, but before doing so to switch off the current. He had apparently operated the switch handle for this purpose (for it was subsequently found in the off position), but afterwards by placing his right hand on the bare wire he got electrocuted. When the switch cover was removed it was found that the release mechanism of one knife was broken, thus leaving one phase alive. The release was controlled by a fine coil spring between the rocking-lever and one end of the knife. The other end of the knife which was struck by the rocking arm was worn away, and there was a slight groove worn in the saddle, so that when the switch handle was moved to the off position it would fail, without the spring, to open the switch. The wearing of these points would put excessive strain on the spring. There was considerable evidence of fusing in the box, and all three springs were gone. When the switch was found to be defective the question of proper maintenance arose. Regulation 4 of the Factory Regulations, applicable in the case, provides that:—

Every switch intended to be used for breaking a circuit, and every circuit-breaker, shall be so constructed that it cannot with proper care be left in partial contact. This applies to each pole of the double-pole or multi-pole switches or circuit-breakers.

It was said that the switch had worked satisfactorily for four years, and was examined and found to be in working order by an electrician about seven hours before the accident; also that the ram driver had hold of the bare wires two hours before the accident. These statements were made to show that up to a short time before its failure the switch was acting properly.

Mr. Nelson was of opinion, however, after an examination of the switch, that it had not been properly maintained, and certainly its failure so soon after inspection by an electrician did not indicate efficient inspection or satisfactory maintenance. The switch had been in use for four years and evidently required renewal, though those responsible for the efficiency of the switch had not thought so, or knowing it, failed to attend to the matter.

(*To be continued.*)

OUR TRADING OPPORTUNITIES THROUGHOUT THE WORLD.

(*Continued from page* 711.)

The Trade of Japan.

Japanese Enterprise.

When the Allied Expedition had finished their work at Tsingtao, the indignant Prussian soothed the people of the Fatherland with promises of frightfulness in days to come, when our gallant little ally, Japan, would duly be reckoned with—only let it "wait and see!" We noted nothing at the time to lead us to suppose that our Ally was quaking in her shoes. We have heard much, however, to prove that that spirit of enterprise and pushfulness which have characterised the progress of the Japanese nation during the last decade or two have been very fully employed, since the cessation of its part in the actual hostilities, in an attack on German trade in the Far East. With the general ambitions of Japan in China we have little immediate concern here. The time chosen for the negotiations seemed to be particularly unfortunate, and some of the proposals as affecting other nations seriously threatened for a few days to "put the fat in the fire." But Japan's commercial, industrial, and scientific activities are not in a state of suspense, whatever may be the present position of international negotiations. Ever since Teutonic trading activities were restricted by our Fleet, and our own exporting ability was limited by our other operations, the attentions of the Japanese have been increasingly given to outer markets. It will be remembered that early in the war a representative deputation went to Australia to see in what branches of trade there would be possibilities of mutual assistance, and a number of interesting proposals were advanced. How far these have proceeded we do not know, but reports from other markets show that Japanese travellers are at work where Germans used to be.

Japanese Manufacturing.

The manufacturing enterprises of Japan have been referred to in these pages on various occasions, and there is little room for doubt that during the last few years great headway in electrical manufacturing work has been made. There is every reason to anticipate a continuance or acceleration of such progress, but the import figures show that the nation is at present dependent upon other countries for very substantial imports. For example, take "dynamos, electric motors, transformers, converters and armatures"; the imports of these into Japan for the past three years have been:—1912, £326,500; 1913, £373,500; 1914, £245,800. We quote below a few figures relating to other allied classes; the falls for 1914 are not of necessity due to the war; they are, in fact, due to the depression in the two previous years, when there was a falling off in orders placed:—

Imports.	1912.	1913.	1914.
Gas engines	£141,900	£124,200	£37,300
Pumps	61,800	110,400	67,900
Steam boilers and accessories ...	119,800	99,700	87,900
Water turbines and Pelton wheels	90,000	74,400	32,800
Dynamos, combined with motive machinery	96,200	64,400	44,500
Steam engines	36,800	58,100	46,200
Fuel economisers	8,600	14,900	8,600
Steam turbines	16,600	6,500	16,600

The foregoing figures are selected from tables given in the annual report (1914) prepared by H.M. Commercial Attaché, at Tokio, Mr. E. F. Crowe. In our estimation that report contains a great deal of material that is likely to be of value to British firms who want to hold and increase their business in Japan.

Our Excellent Position.

It is always useful to know where we stand in comparison with other exporting nations, and this can be seen at a glance in the following figures:—

Machinery Imports into Japan.

From	1912.	1913.	1914.
United Kingdom ...	£1,456,300	£1,737,800	£1,354,500
United States	705,600	754,300	505,700
Germany	658,900	873,600	556,100
France	18,500	24,700	25,000
Other countries	148,300	362,300	104,900
Total	£2,987,600	£3,752,700	£2,546,200

As Mr. Crowe points out, these figures show that the United Kingdom remains well at the head of the list, and has, in fact, slightly improved her position, now enjoying more than 50 per cent. of the business. Though the war was not responsible for the falling off in orders placed for machinery to arrive in Japan in 1914, it certainly interfered to a considerable extent with the deliveries of German machinery. We are constrained to quote Mr. Crowe at length at this point. Comparing the figures up to the end of July, 1914, with those for the whole year, he says:—

"Up to the time when war broke out Germany had 25½ per cent. of this business; by December the percentage had dropped to 21¾. There is still a little more to come forward from Tsingtao and from places where German ships have run for shelter, but when this has all arrived imports from Germany will cease completely and British makers will at last have a fair chance of competing, and it is to be hoped that they will take full advantage of it. Since war broke out very few orders have been placed. At first there was an idea that it would be impossible to get delivery; then when it was seen that this would not be the case, buyers still held off owing to the general uncertainty as to what the future held in store; but confidence is gradually returning, and it is thought that within the next few months it will be possible to obtain a certain amount of orders. There are some points, however, which should be borne in mind. The most important is that Government departments in pursuance of the policy of 'Support home industries,' place their orders in Japan whenever they can possibly do so. Another important factor is that Japanese engineering works are increasing in number and in capacity. Were it not for the heavy duties it would, of course, be impossible for them to compete in a great many lines, but the duty and the freight give them a big advantage which enable them to come fairly near British prices. For this reason it becomes advisable for makers of certain types of heavy British machinery seriously to consider whether it would not pay them to ship only the small, delicate parts and have the heavy castings made locally, thus saving the duty and freight on the latter."

Japanese Support for Home Industries.

"Good castings are obtainable, pattern making is not very expensive, and there are a few works which could be relied on to do accurate machining, so that in cases where there is a probability of a demand for considerable numbers of the same machine it might be advisable for manufacturers to send out their own patterns or to arrange to have these parts made to drawings. Even in cases where only a few machines would be required, but where the incidence of the duty is extremely high on account of the weight, the question might be considered. Naturally, each case would have to be gone into carefully and judged on its merits, and it would be necessary to allow a reasonable margin of profit for the works out here. In estimating the cost of these castings, it should not be forgotten that imported coke, on account of the high rates of freight, costs roughly about 150 per cent. more than in the United Kingdom, and pig iron is about 50 to 60 per cent. dearer. It is true that Japanese coke can be obtained, but it is not suitable, and as double the amount is required there is little economy in using it.

"To many manufacturers, however, it might seem that there would be a danger that machinery constructed in this manner might not be exactly up to the high standard they maintain, and for their benefit I put forward another suggestion which has much to recommend it. This is that makers of small machinery of a class which is sold in quantities in standard sizes, such as gas engines, electric motors, pneumatic drills, pumps, etc., should consign their goods to firms of high standing. By this means, stocks can be kept and a purchaser who finds that he can buy from stock will be more likely to go to the importer than if he has to wait for eight or nine months for delivery—in the latter case he will be tempted to try a Japanese-made copy of a foreign machine which he can get more quickly and more cheaply. The importing firms themselves are rarely willing to tie up their capital stocks, as the profit they can obtain is often eaten up by local high interest charges, while the manufacturer, who has naturally added a considerable amount to his price for standing charges and profit, would only be paying interest on the actual first net cost, and he would also, probably, be able to borrow money at a cheaper rate in the United Kingdom. The merchant would keep the bulk of the goods in bond, so that if it should prove necessary to ship them to some other market, this could be done without loss of the duty. Even if manufacturers do not care to adopt the scheme outlined above they might consider the advisability of some similar arrangement."

Stock Required.

Mr. Crowe emphasises that the reason for bringing these suggestions forward is that the manufacture of machinery in Japan is making considerable progress, and unless some thought is given to the problem we may lose a part of the business which we now enjoy. "It should also be stated that both the ideas mentioned above have been tried during the past two or three years, with, as far as one can learn from the parties concerned, a considerable amount of success."

"One of the interesting features of engineering work in Japan is the very large number of very small establishments in existence—places which appear in engineering directories as "So and So's Engineering or Ironworks," but which really consist of a workshop with one lathe and two or three hands. They have no establishment charges, they work for a very small profit, and consequently they are able, in tendering for Government work, to put in exceedingly low prices. They do not quote direct, they are too small to do that, but a sort of broker takes the contract from the Arsenal or other department and then sub-lets it to these different works. As they are on such a small scale there is a good deal of irregularity in the output and the percentage of rejections is large, but none the less competition from such works is very severe. Naturally, the above remarks do not apply to the big works which are run on more or less foreign lines, although even in these there are points of difference which immediately strike the foreign engineer. For instance, the foreman is invariably on the side of the men and against the office. Then, again, there are no apprentices, no men of a better class gaining practical experience by putting in a certain number of years in the works. The engineers are nearly all graduates of technical colleges with little practical experience. The workmen on the whole are industrious and eager to learn, but their rice diet appears to be against them, for in engineering jobs they lack the necessary bodily weight, and the percentage of days when they are absent on account of sickness is very high. Nevertheless, as their wages are low, and as they are gradually learning and picking up experience all the time, it is well worth while for any maker of machinery who supplies either this or the China market to watch developments and to change his policy as and when required."

Many Small Workshops.

In the section of his report dealing with the rubber industry, Mr. Crowe says that the manufacturers of insulated wire continue to make progress in the technical development of their manufactures, and are now undertaking business for export. The mechanical branch of the industry, which is more open to competition, does not progress so favourably; a number of small mills spring up annually, and each year sees as many disappear. Mr. Crowe gives a detailed account of methods of financing business with Japan, to which we refer below.

One of the results of the systematised attempts to capture German trade has been the large number of inquiries received by the Commercial Attaché's Department relating to the openings for trade in Japan. To many of the inquirers the market is absolutely new, and, on that account, Mr. Crowe presents in more or less tabulated form as much information as he has found it possible to collect on the subject. Such a task has, he says, never been attempted before, and as it has been necessary to obtain particulars from many sources there may be errors and omissions, but he invites corrections for incorporation in future reports. He touches first upon the methods of financing business with Japan.

Terms and Conditions of Business.

These are probably very similar to those in vogue in other countries, but for the sake of clearness they are set forth in detail, and we quote them below:—

Financing Import Trade.

"It is doubtless well known that there are certain old-established Eastern banks which make a speciality of this kind of business, and also that practically all the financing of Japan's trade is arranged through London.

"In connection with the import trade, the different methods whereby goods shipped to Japan are financed and paid for are as follows:—

"1. The shipper draws a bill of exchange on the importer against complete shipping documents for the relative goods, which he negotiates with a bank. The bank forwards the draft and documents to its branch office at the port of destination, who obtain payment of the amount of the draft on the due date of same, from the drawee, against delivery of the documents in question, thus meeting the advance made by the bank's office which negotiated the draft. The bills are usually drawn in the currency of the country where they are negotiated (the most common usance being either three or four months' sight), and bear interest at a rate fixed from time to time by the Associated Exchange Banks (at present 7 per cent.) from the date of the draft to the date on which the same is paid. Business done on the above lines is gener-

ally arranged by the importer in the first place by requesting the branch of the bank at the port of destination to open a documentary letter of credit, authorising its office at the port of shipment to negotiate the drafts of the shipper drawn in accordance with the terms of the letter of credit, he, in turn, undertaking to accept and pay the same in due course. The face value, plus interest, is collected at due date at current rate of exchange.

"2. Either the importer or the shipper may arrange with a bank to open a confirmed banker's letter of credit, whereby the shipper is to draw a bill of exchange on London correspondents of the bank, who accept the said draft, which is subsequently discounted in the open market. The relative documents are sent to the branch office or correspondents of the bank who bought the bill at the port of destination, and are delivered to the importer against payment of the amount of the draft, this sum being remitted to the bank's London office in time to meet it when due. The usual charge made for accepting such drafts is ½ per cent. per month according to the usance of the same; generally bills are drawn at 90 days' sight (the commission therefore is ¾ per cent.).

"3. The shipper hands to a bank a draft and documents for goods shipped. The bank forwards the same to its branch office at port of destination, to be delivered to the consignee against payment of the draft, which amount is remitted either by T.T. or demand draft to be paid to the shipper, less the bank's commission for collecting the amount in question, the bank having made no advance against the goods.

"4. There is another way which is, however, only made use of by the largest firms who have head or branch offices in London. The manufacturer or agent, who is shipping the goods, draws a bill at four or six months' sight on the London office of the firm doing business in Japan, and after getting it accepted, discounts it in the open market. The goods are forwarded to Japan and the Japan branch makes a remittance to London in time to meet the bill at due date. Sometimes when firms have already got enough of their paper on the market they arrange with one of the well-known accepting houses to accept bills drawn on them.

"5. Firms doing both import and export business sometimes work independently of the banks, by sending their export documents—say to their London houses to set against shipments being made from London to Japan. Obviously this method also can only be adopted by large firms.

"With regard to the export trade, the methods of financing shipments to other countries may be put under four headings:—

"1. For the shipper to obtain bank credits under which he draws a draft direct on the issuing bank, with full shipping documents attached, these drafts being accepted by the issuing bank on behalf of the consignees and the documents delivered on acceptance. Such credits generally call for drafts to be drawn at either three, four, or six months' sight (*i.e.*, payable three, four, or six months after acceptance.)

"2. Documentary letters of authorisation issued by the consignees, enabling the shippers to draw direct on them, documents being delivered on payment of drafts only. Drafts under these letters of authorisation are usually drawn at from 30 days' to four months' sight.

"3. For the shipper to draw documentary drafts on the consignees, documents being delivered on acceptance or payment, as the means and standing of drawees warrant. The usance of these drafts being generally the same as in the case of letters of authorisation.

"4. For the shippers to draw clean drafts on their customers and handle the documents themselves, such drafts being drawn at varying usances from sight to six months.

"In connection with the first method, it might be mentioned that many of the bank credits on London cover shipments to America, one set of documents going direct to the issuing bank in America, and the remaining documents being attached to the draft drawn on the accepting bank in London.

"It is usual for drafts to be drawn in the currency of the country to which the goods are shipped, with the exception of shipments to America under bank credits on London, which in the majority of instances call for drafts to be drawn on a London bank in sterling.

"The rate of exchange for converting the currency of a draft from yen varies in all cases with the usance of the draft, and the face value is collected at due date.

"With regard to the customary terms and conditions in the various lines of business, it is difficult to be precise, as the terms naturally vary considerably according to the standing of the parties concerned, but as a general rule it may be stated that the German firms made a practice of giving longer credits than British firms, and the chief distinction between import and export business is that in the case of the former credit from 30 to 90 days or more has to be allowed, while in the case of the latter cash has nearly always to be paid, and in some instances even an advance has to be made to dealers.

"No discount is allowed for cash in paying for exports.

"It will be noticed that payment in the import trade is generally made with promissory notes, due in 30, 60 or 90 days. The promissory notes can be discounted with Japanese banks, but they are the source of much trouble and litigation, and a demand is frequently made for their renewal.

Promissory notes can very rarely be discounted without recourse. In these cases a higher rate has to be paid and the firm has to be of the best standing.

"The great bulk of the import trade is done against orders. It is only in the case of low qualities of Indian cotton that goods are sent on a large scale to be sold on consignment in this market."

"*Machinery.*—The conditions with regard to machinery vary perhaps more than in the case of any other imports. The first distinction is between Government, municipal and private orders. The Imperial Government railways have their own inspectors abroad, and on the presentation of their certificate of inspection, payment is made on delivery of the goods after a further inspection in Japan on arrival, chiefly with regard to measurement. With Admiralty and War Office orders to the value of under about £25,000, inspection is made within 15 days of delivery at destination, and payment within 15 days from inspection. With large orders such as for warships, payment is spread over the course of construction into about five to ten amounts. The Admiralty generally place their important orders through inspectors in London, but the negotiations are carried on through agents in Japan. In such cases payment is made f.o.b. British ports, and freight is arranged by the naval inspectors with the Japanese steamship companies. In the case of the larger municipalities prompt payment is made after delivery and local inspection, or when erection of the machinery is also undertaken, after completion of the tests.

"With private companies of the best standing each contract is generally negotiated for separately, but, roughly, the rule is that about 70 per cent. of the money is paid on delivery, 20 per cent. is paid after the lapse of another three months, and 10 per cent. remains unpaid for a year or more as part of the guarantee for fulfilment of obligations. It is, however, customary that about 10 per cent. should be deposited as bargain money at time of placing the order.

"In Government business the reverse is the case, and the importer has to put up a deposit of 10 per cent., which he is liable to forfeit if he cannot implement his contract.

"With small companies payment is very much delayed, often over years. A recent case which came to my notice is a good example of what sometimes happens. A British firm secured an order for machinery and turbines on the following terms:—60 per cent. payable on arrival, and 40 per cent. on completion of erection and tests. The company's plans were altered and the final erection will not be completed for more than two years after arrival, during which time, under the contract, 40 per cent. of the money due is withheld. British firms rarely take payment in shares, but German firms frequently arranged to do so, and they thus acquired a sufficiently big interest in the company to insure their getting paid a high enough price to compensate them for the risk they ran.

"In the case of big contracts, prices for machinery are generally quoted delivered to purchaser's site, but for Imperial Government Railway orders the customs duty is not included in the price. Delivery is generally to one of the railway compounds.

"Sales of machine tools are often made out of stock for cash. This also applies to many lines of a nature where stocks have to be carried, such, for instance, as files, saws, locks, etc. With gas engines and some other goods, although stocks have to be carried, credit has to be given."

(To be continued.)

SOME DIFFICULTIES OF DESIGN OF HIGH-SPEED GENERATORS.

By PROF. A. B. FIELD, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *November*, 1915.)

(*Continued from page* 734)

Coil-retaining Rings.—As regards the part of the rotor windings external to the core, we have a very serious problem to meet in supporting this free copper. Of the methods so far used or proposed, the most satisfactory, for machines of the size considered here, is the use of a weldless chrome-nickel steel ring proportioned to carry its own load and that of the copper underneath it without any radial support from the rotor. The severe conditions to be met here may be inferred when it is recollected that this steel ring would have, due to its own weight only, and without any of the copper load which it has to support, a stress of 17,000 lb. per square inch when running at normal speed. The best properties obtainable are required for this ring, although we cannot, of course, expect to get as good characteristics in the steel of a ring of this size as we could in a small bolt. However, we can depend on getting properties as least as good as the following:—

Ultimate strength	120,000 lb. per sq. in.
Yield point	100,000 lb. per sq. in.
Elongation	18 per cent. in 2 in.
Reduction of area	50 per cent.

The fractures are always silky, and in most cases beautifully symmetrical cup fractures.

The importance of inspecting and testing in the case of these rings is very great, and at least four test-bars should be taken from each ring. As it is also important to obtain the most favourable forging conditions possible, the width of the ring should preferably be such that it can be accommodated in a tire-mill, the uncertainties introduced by forging on a mandrel being thus avoided.

The rings must be positively driven by means of a key, and this is best located in the rotor body rather than in the outside end disk. In considering these details we have to provide for possible short-circuit conditions involving a considerable retardation shock to the rotor. For these reasons we make provision for driving forces of the various parts which would otherwise appear to be unnecessary.

Steel is used for the retaining rings, in spite of the electrical and magnetic difficulties which it introduces because in such matters the mechanical considerations must take precedence over everything else. It will, however, be noticed that the rings tend to form a magnetic short-circuit from pole to pole, and in fact they do account for a large leakage. The design of the tip of the ring, and its connection with the rotor body, are arranged to reduce this evil as far as possible, and a comparatively slight variation in this respect can make a large difference in the leakage in the case of a 4-pole rotor. The 2-pole machines of large size saturate their ring cross-section almost necessarily, and in this case the end disk which centres the ring at its outer end, is made of manganese bronze to obviate further leakage. In the 4-pole machine this disk is made of steel, without appreciably affecting the leakage.

Some of the more obvious ways of diminishing leakage, and at the same time obtaining ventilation of the copper supported by the rings, are of a nature which seriously affects the strength of the ring, and are therefore undesirable. Any slotting of the tip of the ring which breaks the continuous circle results in so much extra dead load being put upon the ring material immediately behind the slotting; further, in the case of this alloy steel it is of the greatest importance to have fillets everywhere, and entirely to avoid any sharp corners or notches. The key-way which necessarily cuts through the tip of the ring is made as shallow as possible and is provided with good fillets. It has been the practice of some companies to use for these rings either 25 per cent. nickel steel, or a manganese bronze. While both these materials have the great advantage of being non-magnetic, they also have some mechanical disadvantages, but they are feasible for small machines. For the machines under discussion there can be no question as to the advisability of using the best material from the mechanical point of view, and neutralising the effects which are injurious from the electrical standpoint.

So long as the load on the generator is a nearly balanced 3-phase (or 2-phase) load, the objection to a magnetic end-ring is chiefly on account of the extra flux with which it burdens the rotor. It is true that the projecting stator coils to some extent overhang the steel ring, and that the leakage flux from these penetrates the ring and is increased by the presence of magnetic material there, but this flux sufficiently approximates to a rotating field of constant magnitude for comparatively small losses to appear in the rings on its account. Occasionally, however, the system of distribution from the power house is such that a balanced condition of phases cannot be obtained; in this case the leakage flux from the stator coils is no longer a simple rotating field, and very large losses would occur in the magnetic steel end-ring in consequence.

While this matter had been recognised by us for many years, it first became necessary to tackle it seriously when the problem arose of building several 4-pole, 60-period generators of nearly 20,000-K.V.A. rating which would be required to operate upon a considerably unbalanced 3-phase load. Such preliminary investigations as could be made upon a similar existing distribution system indicated that we ought to provide for unbalanced conditions equivalent to a 3-phase load of half the rated kilovolt-amperes, upon which was superposed a single-phase load of the same number of amperes. A little investigation shows that a comparatively thin sheet of drawn copper outside the ring would carry sufficient current to protect the magnetic material below it from this stray flux. The sheet, however, would require an increased cross-section at the outer end of the ring and again at the end near the rotor body, unless the sheet could be effectively connected electrically to the slot wedges of the rotor. The difficulty of safely providing such a protective shield would be quite considerable, not to mention the liability of having trouble from it in operation. For the machines above referred to, for unbalanced-load conditions, the difficulty was overcome by dividing this sheet into a number of hard-drawn copper strips about 3/16 in. thick, which were driven and caulked into axial dovetailed grooves upon the surface of the ring, thus covering about 80 per cent. of the entire perimeter with copper and maintaining a thoroughly substantial construction. In order to provide the copper for the circumferential path of the protecting current, dovetail grooves were turned in the chrome-nickel steel ring near its outer end; into such a groove was fitted a pair of heavy copper strips of rectangular section side by side, and by means of hydraulic pressure these strips were pressed in and made to expand and fill the dovetail section of the groove. For mechanical reasons this copper was distributed in two grooves instead of one. As it was not feasible to depend entirely upon the electrical connection of the ring with the rotor body, it was necessary to provide similarly a circumferential path at the other end of the ring, and for this purpose a short section of ring was made of manganese-bronze and securely united to the chrome-nickel steel ring. In making the axial dovetail grooves to carry the copper strips, all these conducting rings were cut through at the same time as the steel, and good electrical connections obtained between the strips and the conducting rings by caulking. While the short length of manganese-bronze rings could if necessary be carried as a load by the steel ring, it was desirable to make this, so far as possible, self-supporting and to obtain the very best properties in this material. A number of experiments were required before we were able, by applying a certain amount of cold forging to the cast-bronze ring, to obtain results which might almost be considered remarkable in a cast ring of such dimensions. The following figures indicate the results of tests on bars taken out of these bronze rings:—

Ultimate strength	75 to 86,000 lb. per sq. in.
Yield point	60 to 73,000 lb. per sq. in.
Elongation	12 to 15 per cent. in 2 in.
Reduction of area	20 to 30 per cent.

It will be noticed that in addition to this bronze ring being necessary owing to electrical considerations, we gain the magnetic advantages of having a separator between the steel ring and the rotor body. In fig. 6 can be clearly traced the axial bars and circumferential copper rings referred to here. Some of the other features of construction already described are also evident; in particular the ventilating grooves located at the plate interfaces.

It is hardly necessary to point out that the unbalanced load affects the flux conditions in the main body of the rotor also, and must be provided for by heavy longitudinal dampers. In the slotted region of the circumference, the slotwedge is used for this purpose, being made in continuous lengths and of hard-drawn copper; elsewhere special dampers are inserted. These dampers complete their electrical circuit by means of all the circumferential copper and bronze of the end-rings; and the design of the bronze section of the ring is such as to ensure the electrical connection being improved rather than the reverse by the stresses arising upon rotation. The adequacy of this rotor protection is best illustrated by test figures. Single-phase and 3-phase short-circuit runs were made upon these machines, the power absorbed being measured, less that due to friction and windage. This was found to be only 10 per cent. greater when the machine was delivering rated current on a single-phase short-circuit than for the same current on a 3-phase short-circuit, thus indicating only a very small additional loss due to the unbalanced single-phase effect. In similar machines without this balancing device the extra power absorbed on a single-phase short-circuit is very high indeed. Perhaps it may be well to mention here that in the case of turbo-generators the total loss on a short-circuit test is very great in comparison with the product of the square of the currents flowing and the resistances of the stator windings. Hence the fact that in the single-phase run only two-thirds of the winding is involved does not vitiate the excellent nature of the single-phase short-circuit results given above.

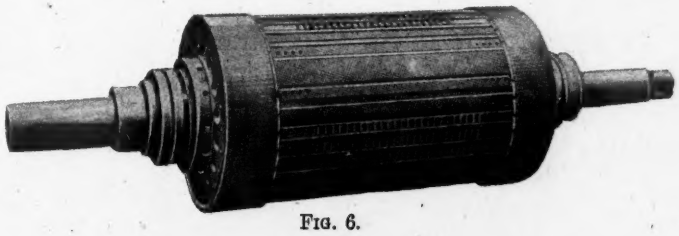


Fig. 6.

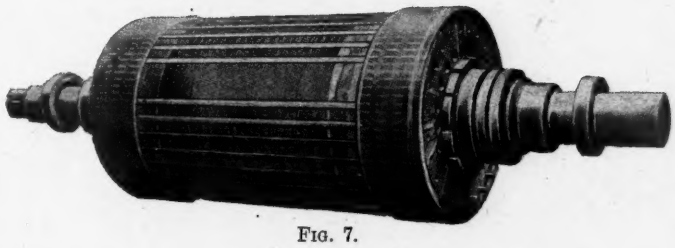


Fig. 7.

Several large 2-pole, 25-period, single-phase turbo-alternators have been constructed upon somewhat similar lines. Fig. 7 shows such a rotor for a machine of a little over 11,000 K.V.A.

single-phase rating; the stators of these machines were insulated for a one-minute puncture test of 30,000 volts. The Westinghouse Co. advised that they are now building 2-pole single-phase machines of a rating 25 per cent. greater than the above.

Rotor Coil Bracing.—The necessity of a positive key-drive for the rotor end-rings has been indicated. In a similar way the problem of the circumferential bracing of that part of the rotor winding which is external to the core must be faced. In the case of 4-pole machines having only three heavy coils per pole of less than 90 deg. pitch, no very special means are needed. In the case, however, of 2-pole machines where the coil-span is twice as great, and where we have of necessity more coils per pole, involving a greater length of straight extension from the slot, it is important effectively to brace the windings. A number of considerations enter into this matter, such as a possible very slight change of position of the end-windings between the stationary and full-speed conditions;

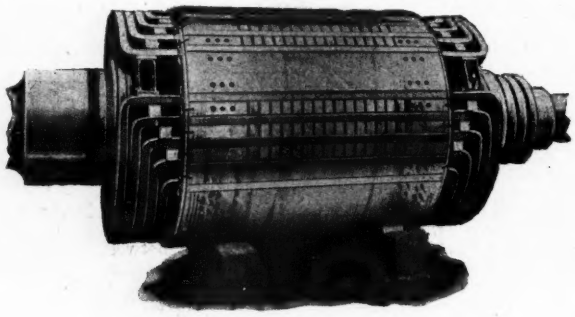


FIG. 8.

also the necessity of thoroughly anchoring any blocking device used, and the desirability of avoiding extra centrifugal load upon the end-rings by reason of these accessory parts. In view of the nature of the effects to be guarded against, mere blocking from coil to coil will be ineffective, and we require some driving device rigidly attached to the metal of the rotor itself. Fig. 8 illustrates the system of blocking adopted for a 21,000-K.V.A., 2-pole machine in which a light built-up steel driving-horn is located on the interpole centre line of the rotor, being firmly attached to the shaft by heavy chrome-nickel steel bolts. The shaft diameter at this place is but little smaller than the inside diameter of the coils, so that a very effective stay is obtained. With this provision made for the coils of largest span, it merely becomes necessary to block the succeeding coils from these and from one another. This is effected without departing from the principles enunciated above, by the use of a metal block carried by a radial chrome-nickel steel stud having some degree of flexibility and acting merely as a tie and anchor. Substantial insulating shoes separate the coil from the block.

(To be continued.)

DISCUSSION AT BIRMINGHAM.

The paper was read and discussed at a meeting of the BIRMINGHAM LOCAL SECTION on November 24th.

Mr. F. W. CARTER (Rugby) wrote that Prof. Field's paper was one for experts, and those whose work lay in other directions could hardly discuss the main topic. He asked whether Prof. Field had met with trouble from end thrust in the type of generator considered. With the usual flexible coupling between turbine and generator there was a tendency for the rotor to be pushed with considerable force towards one end; the tendency could be balanced against a magnetic centring force, but this sometimes led to local heating from the undue crowding of flux in some of the end punchings of the stator. He believed the proper remedy to lie in attention to the correct design of the coupling, which was undoubtedly the source of the end thrust. Prof. Field had referred to a formula of Mr. Carter's giving the pole-face losses, and appeared in doubt as to what it represented. It was the result of a direct calculation starting with Maxwell's equations and carried through on orthodox lines. It represented very closely the actual loss under the assumed conditions, and he would himself trust it in preference to any empirical formula, for experiments designed to separate out such a loss as this were by no means easy, and were not likely to yield very consistent or reliable results.

Mr. T. H. HURST (Loughborough) spoke as to the desirability of a new specification being issued by engineers regarding the temperature rise permissible in large generators. He pointed out that the present restrictions unnecessarily limited the development of these machines.

Mr. F. H. CLOUGH (Rugby) stated that the crux of the whole question of the design of large generators was, in the author's view, associated with critical speed. In his opinion, the author had laid too much stress upon critical speed, and if he had regarded this factor less he could have produced a simpler design and smaller cost. Machines were built to run satisfactorily through and above their critical speed. He could not approve of the author's three-part wedge, as the coils could be pressed and held in position without wedges. He also thought that a fan on the rotor was preferable to a separate fan.

Mr. R. J. KAULA (Rugby) said there was a great deal to be said in favour of a separate fan system for the cooling of rotors as against the arrangement of the fan on the rotor; he also stated that solid couplings had been provided with satisfactory results on large machines for connecting the generator to the turbine.

Mr. B. A. B. BOYCE (Loughborough) commented upon the title of the paper, and remarked that it related to high-speed generators. Seeing that there was no mention in the paper of D.C. generators, he wanted to know if these were now completely out of date.

Mr. E. KILBURN SCOTT (Birmingham) asked for information as to the limit of size possible in machines of the type described by the author. In his view, the limit would possibly determine the question as to whether or not the British chemical industry could compete with Continental concerns deriving their power from hydroelectric systems. The latter were able to provide cheaper current than the present common steam-driven plants. If the generating units of the latter could be so increased as to bring down the cost of energy to a figure comparable to that of a water-driven plant, then it would be possible for important industries to be established in this country.

Mr. H. W. TAYLOR (Rugby) also mentioned that there was no need to limit the speed of high-speed generators below the critical speed, as satisfactory running above that speed was obtained in practice.

Mr. A. M. TAYLOR (Birmingham), commenting upon the author's statement that these large machines should be so built as to stand a dead short-circuit at their terminals, said that it rather supported the contention which he had previously put forward, viz., that a certain amount of external reactance was desirable between the machine and the bus-bars in those cases where the bus-bars were connected with a large number of other alternators. The argument for the external reactance was, briefly, that there was a possibility of a short-circuit occurring in the end windings of the stator in such a position as to cut out a large proportion of the reactance of the stator; consequently, if connected directly with bus-bars to which many other machines were connected, the flow of current from these bus-bars into the short-circuit would be many times that which would flow into a short-circuit at the machine terminals if fed merely by the machine itself. Hence a short-circuit test of the machine made after erection, which could only be tried under the latter conditions, would be no criterion as to what would happen under the former conditions; in this case such forces might be set up in a part of the winding of the alternator as to wreck the end connections. Probably the best combination of internal and external reactance was that which permitted the machine to be short-circuited on itself when on test, without its reactance; the (external) reactance being so designed as to pass only the same current from the bus-bars, in the event of a short-circuit occurring in the machine and near the terminals of the machine, as the machine had been previously tested with when tested without the reactance. It was undoubtedly easier to insulate the turns of the reactance, where they were not cramped for room, than the end coils of the stator, where they were both cramped for room and were forced to be bent and twisted about in addition.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

A Contractor's Complaint.

A letter appearing in your issue of November 12th last, under the above heading, and signed "J.S.L.," causes me to write calling your correspondent's attention to the fact that there are a number of associations of electrical contractors in the country at the present time endeavouring to carry out the objects he suggests, viz.: To protect the rights and interests of electrical contractors.

The Association of which I am secretary has a very strong and influential electrical contractors' section, which is working most strenuously in this matter, and I have reason to believe that similar branches of the Building Trades' Federation throughout the country are organised and acting in a like manner, and steps are about to be taken to link up these various organisations through our national bodies for one united effort in the hope of attaining the object in view.

I can only, therefore, advise your correspondent, and all other electrical contractors in the country, either to become affiliated to the Building Trades' Association of his district and form strong electrical contractors' branches, or to become affiliated to the nearest branch of the Electrical Contractors' Association, and so organise themselves in a united body, and thus be able to place their rightful demands before the proper quarters.

In my opinion, it is no use complaining against manufacturers supplying their wares to anybody, irrespective of whether they be tradesmen or otherwise, unless some joint mutual arrangement can be made with them, and their interests protected, and, of course, as this cannot be done by each firm individually, it must be accomplished through a united organisation, and the stronger that organisation the better hope we have of attaining success.

James Denver, *Secretary,*
Manchester, Salford, & District Building Trades' Employers' Association.

Manchester, *December 2nd*, 1915.

The A.E.G. Meeting.

I should like to draw the attention of your readers who are interested in the correspondence appearing under the above heading to a most illuminating article in this month's *National Review*, entitled "The Germans in England, 1915," from the pen of Mr. Ian Colvin.

Mr. Colvin investigates at considerable length the ramifications of the Allgemeine Elektricitäts Gesellschaft, both in this country and elsewhere.

E. P. Allam.

Romford, *December 3rd*, 1915.

The Institution and Alien Enemy Members.

Having learnt from the correspondence that has arisen out of my first communication that there exists a strong feeling in respect of this question, I desire to trespass again on your valuable space to summarise the position as it appears to me.

Although we have been at war for practically 18 months, the Council of the Institution have in no way considered the personal feelings of those members who do not desire to meet or come in contact with members of alien origin; consequently, no steps have been taken to call upon such members to resign, and as it is now stated that they have no legal authority, nor have they taken any steps to obtain it, it can be correctly assumed that they are in sympathy with such members and view them as being more desirable than those who claim the discontinuance of membership and privileges to those of alien enemy origin.

One seeks to find the reason, either from the members' or the Council's point of view, why they should continue their membership, and can only judge it to be one of the following :—Scientific, Social, or Commercial.

Scientific.—If this, and it is assumed that the furtherance of electrical science would be hindered, give the exclusion a trial, and if the Institution finds it cannot proceed with scientific research, ask these members to put themselves forward for re-election.

Social.—The writer has intimate personal knowledge of alien enemy acquaintances (not business, therefore not now referred to), and he has lost nothing by refusing to have any further intercourse with people of a race that has to its credit such noble deeds as the outrage on Belgium, the sinking of the *Lusitania*, the shelling of drowning women and children of the *Ancona*, Zeppelin outrages, and the brutal treatment of war prisoners, and he fails to see where the loss from the social side would arise.

Commercial.—The Institution prides itself that it is not interested in the commercial side, but, having regard to its treatment of this question, one wonders whether the objects of the Institution have been modified.

That there is no stone being left unturned to prevent the exclusion of members of alien enemy origin taking effect is evident by the campaign now being carried on amongst central station engineers and others to kill further agitation, and, having regard to the fact that members in commercial undertakings dare not express their views, I think the only solution lies in the following :—

1. That all the Associations who have petitioned the Institution shall continue to agitate, irrespective of what attempts may be made to stop such agitation.

2. That all subscribers will avail themselves (as suggested by another correspondent) of clause 37 of the Articles of Association, namely, "that no subscription will be paid until December, 1917."

If this is done, I am certain that the Council of the Institution, whilst not having seen it necessary to call a general meeting under clause 80 of the Articles of Association, "to consider what steps should be taken to exclude members of alien enemy origin from the Institution," may find it in the near future to be in their interest to call a general meeting so as to amend clause 37, as the effect of the economic conditions would become probably quite apparent to the Institution, and it might then not be prepared to sacrifice financial stability, though by not caring to offend a few influential subscribers they failed to call such a meeting for the purpose of excluding members of alien enemy origin.

In conclusion, it seems to me that this step is one which can be safely taken by all subscribers to the Institution without any fear of its being construed as taking any active propaganda in respect to this matter, and, consequently, prejudicing their professional appointments.

Station Engineer.

December 6th, 1915.

Swiss or German?

With reference to the letter of "A.M.H." in our last issue, and our reply thereto, we may now quote the following paragraph from an article on "The Germans in England—1915," by Ian D. Colvin in the current *National Review* :—

"In Switzerland the A.E.G. aims at obtaining complete control, no doubt regarding Switzerland as the power-house of Europe. The Electro Bank of Zurich is practically a branch of the A.E.G., and is devoted to the financing of enterprises which are tied to the A.E.G. for life and are bound to use only A.E.G. machinery."

Under such circumstances, we confess to being deeply touched by "A.M.H.'s" solicitude for the interests of British manufacturers and their future part in international electrical undertakings The "voice of Jacob"?—Eds. Elec. Rev.

WAR ITEMS.

Recruiting Notes.—Before the introduction of the Derby Scheme the St. James' and Pall Mall Electric Light Co., Ltd., had 56 men with the Forces out of a total of 198 men employed in all departments. The remainder of the eligible ones, 44 in number, have now been attested. The Central Electric Supply Co. before Lord Derby got to work with the present scheme had 39 men with the Forces out of a total of 239. The remainder of those who are eligible (52 in number) have now been enrolled.

Some hundreds of employés from the Westinghouse Works at Trafford Park attended in a body for attestation under the group scheme in Manchester last week-end.

Out of a regular staff of about 56, the South Shields Corporation Electricity Supply Department has 11 now with the Forces, one has returned unfit for service, and one was drowned when H.M.S. "Hawke" was sunk early in the war. The present staff numbers only 44, which is considered to be an irreducible minimum if the work of the department is to be carried on. Of the present staff there are 18 males of recruitable age, seven of whom have been certified unfit for military service. Including Mr. H. S. Ellis, the borough electrical engineer, the remainder have enlisted under Lord Derby's scheme, Class B, although the majority of them are already starred men. All men of recruitable age still wear the Admiralty badge which was obtained for them several months ago, and all men above recruitable age now wear the Ministry of Munitions badge. It will be left to the local tribunal to decide as to which of the remaining men will be called up for military service.

Already a large number of men of the Burnley Corporation Electricity Department have enlisted, and on December 3rd 25 out of 26 eligibles, including the electrical engineer, Mr. J. E. Starkie, attested under Lord Derby's scheme. Being badge men they cannot be called on for immediate service. The department is now working at higher pressure than ever before, the consumption a fortnight ago being 30 per cent. more than last year.

The Bristol Corporation Electricity Department has 77 members of its staff and employés with the Forces. These are from the management and clerical staff, power and substations, "outside" men, and storekeepers and motor-men. In addition, 61 have volunteered for the Derby Reserves "B," and six are in the Naval Reserve. Fifty have been rejected, making the total offering from the department 194. The remainder of the staff consists of 70 men who are over age, 16 who are under age, three who are physically unfit, and 13 ladies. There are also two men of military age badged and three not badged, bringing up the total staff to 301, 38 of whom have been appointed since the outbreak of war. Of the men who are serving with the Forces, 25 are married and 52 single; of those in the Derby Reserves "B," 46 are married and 15 single; of the rejected, 30 are married and 20 single. All the over-age men save four are married, and all the ladies are single.

The whole of the officers and employés of the Islington Electricity Department, technical, engineering and clerical, were attested on Monday under Lord Derby's scheme. The department already has 36 employés (both officers and staff) in the fighting forces.

Tramway Supplies in War Time.—The "Journal" of the Tramways and Light Railways Association states that in October the following communication was sent to members of the Association:—"The Sub-Committee appointed by the Council to deal with the question of future supplies recently interviewed the manufacturers' representatives, with a view to ascertaining what steps could be taken to ensure a sufficiency of tires being obtained for our members during the war, when it was unanimously agreed that the supply of tires would be facilitated by—(a) The adoption of a standard section, especially so far as the profile of the tread and the width are concerned, both in regard to driving and pony tires, as this would enable the manufacturers to (1) increase their output, (2) do away with the delay and expense which is necessarily incurred by changing rolls, and (3) maintain stocks. (b) The preparation of a list showing the actual requirements of each undertaking and the name of the supplier." The circular enclosed a blue print of the sug-

gested standard section and a list of questions. After receipt of the replies the Sub-Committee proposed to again approach the manufacturers on November 24th. No member was to be committed to the purchase of tires without his consent.

American Electrical Apparatus for Russia.—The last number of the New York "Electrical World" to hand contains the following:—"With the conclusion of the war in Europe electrical apparatus of American manufacture will be greatly in demand in Russia, according to a statement made by Nicolai Fedotoff, electrical engineer for the Petrograd branch of the Siemens-Schuckert company, to a representative of the "Electrical World." Mr. Fedotoff has just arrived in the United States from Petrograd and expects to make a study of the manufacture of telephone material with the intention of placing here a large order. Electricity is now widely used in Russia, he stated, and when the war is over the necessity for the rehabilitation of the empire's industries and the large demand that will be made on them for the reconstruction of the war-swept areas will create a tremendous demand for generators, motors, line equipment, and all of the other electrical equipment which is needed for industrial installations. A further point brought out by Mr. Fedotoff in this connection was that American and English technical men of sound training would be needed by Russia. The war has taken many of her engineers, and when the period of reconstruction begins their ranks will be found to be seriously depleted. For this reason Russia will offer a brilliant opportunity to engineers who have received their training in England or the United States."

German-Owned Companies.—In the House of Commons on Monday a member asked what steps it was proposed to take to deal with the registered companies under the cloak of which Germans and other enemies were enabled to continue their business and connections in this country, whether the shares were nominally held by British investors or not. According to the "Standard," Mr. Pretyman (Secretary, Board of Trade) replied that practical steps were taken by the Board of Trade to prevent any trading with the enemy by such companies as were referred to in the question. Consideration was being given to the question whether any steps should be taken after the war to prevent the registration of companies, the majority of whose shares were under foreign control.

The Earl of Halsbury has introduced in the House of Lords a Bill to amend the law relating to enemy companies registered as British companies. The Bill was read a first time last week.

From the Front.—A correspondent with the British Expeditionary Force writes:—"Very many thanks for the copies of the Electrical Review. They are reaching me quite all right, and receive a very warm welcome, bringing, as they do, just the news one is anxious to hear, besides the technical articles, which profitably fill up otherwise idle moments. We have been having some real wintry weather just recently—heavy falls of snow, hard frosts, and, of course, plenty of rain, the days when one's thoughts turn to peak loads. Power consumption at the present time must be fairly heavy. It is only in rare instances one meets people one knows out here, then it is a mere coincidence. Once only have I happened across a friend in this way. The cold days sometimes make me wish I could get my back against a nice warm turbo set, although I must say that, as regards clothing, we are well equipped."

Russian Electricity Students and the War.—At a recent meeting of the students of the Petrograd Electro-Technical Institute, a proposition was unanimously adopted that at the present time the students, as a body, should devote their whole strength to the defence of the country, and a subcommittee was appointed to organise the students of the Electro-Technical Institute. Already this committee has found it possible to address the factories working on the preparation of military materials and propose to them to use the students of the Institute, who are completely equipped to take the place of instructors. The Committee of Mobilisation of the Students' Energy is ready to place 300 student-instructors at the disposition of the factories requiring them.

Russia.—The new Board of Control of the 1886 Electric Lighting Co. (Moscow) has stopped credit to its clients. It requires immediate payment of all debts, threatening to stop delivery of current. This request it explains by the extraordinarily high price of fuel, immense difficulties in obtaining machinery, and the very onerous conditions of the money market.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

16,443. "Methods of and apparatus for producing and distributing electric current waves." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). November 22nd.

16,452. "Electric soldering irons." J. G. Clemens. November 22nd. (Convention date, November 21st, 1914, U.S.A.) (Complete.)

16,464. "Dynamo-electric machinery." A. C. Eborall (Akt. Ges. Brown, Boveri et Cie, Switzerland.) November 22nd. (Complete.)

16,466. "Electric contact thermometers." R. P. Costello. November 22nd.

16,469. "Portable electric and other lamps." C. H. Hefford. November 22nd.

16,471. "Method for producing durable galvanic battery cells with zinc anodes and alkaline electrolyte." J. N. Bronsted and H. Enke and V. Ludvigsen. November 22nd. (Complete.)

16,474. "Magnetos." J. L. Didier. November 22nd. (Convention date, September 3rd, 1915, France.) (Complete.)

16,475. "Magneto-ignition systems." Etablissements de Dion-Bouton Soc. Anon. November 22nd. (Addition to 16,408/15. Convention date, October 28th, 1915, France.) (Complete.)

16,476. "Alternating-current motors." A. H. Neuland. November 22nd. (Complete.)

16,479. "Loaded telephone line system." Western Electric Co., Ltd. (Western Electric Co., U.S.A.). November 22nd. (Addition to 12,434/15.) (Complete.)

16,492. "Metal and carbon filament electric incandescent globe and like illuminators." M. Steele. November 23rd.

16,495. "Ignition and electric lighting apparatus for automobiles." Wright and Bull, Ltd. (trading as St. Martin's Motor Works) and A. Moulin. November 23rd.

16,502. "Electric switch appliances." Mavor & Coulson, Ltd., and W. Lawrence. November 23rd.

16,508. "Insulation system for cells and batteries." K. O. Leon. November 23rd.

16,516. "Electric batteries." F. J. Beaumont. November 23rd.

16,534. "Centrifugal pumping apparatus." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). November 23rd.

16,540. "Electric batteries." E. C. R. Marks (Interstate Electric Novelty Co., U.S.A.). November 23rd. (Complete.)

16,550. "Telegraph or telephone line insulator." J. B. Alexander. November 23rd.

16,565. "Clamps or supports for coils or windings when used on electric circuits." P. W. Scholefield. November 24th.

16,569. "Electric lampholders." E. Dewhurst. November 24th.

16,591. "Systems of radio communication." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). November 24th.

16,602. "Electric furnaces." F. Cochlovius. November 24th. (Convention date, November 24th, 1914, Switzerland.) (Complete.)

16,614. "Magneto-electric generators." Etablissements de Dion-Bouton Soc. Anon. November 24th. (Convention date, June 17th, 1915, France.) (Complete.)

16,640. "Dynamo-electric machinery." Electromotors, Ltd., & E. Green halgh. November 25th. (Complete.)

16,643. "Electrolytic cells." H. C. Jenkins & C. I. Syndicate, Ltd. November 25th.

16,647. "Electrical connection." H. G. Cockrell. November 25th.

16,671. "Electro-dynamic brakes for use in connection with printing machines." H. V. James. November 25th. (Addition to 596/15.) (Complete.)

16,692. "Winding drums for electric wires, cables, and the like." H. F. Smithson and Callender's Cable & Construction Co., Ltd. November 26th.

16,694. "Electric arc lamps." A. H. Railing & A. E. Angold. November 26th.

16,695. "Electric arc lamps." A. H. Railing & A. E. Angold. November 26th.

16,721. "Vehicles." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). November 26th.

16,730. "Apparatus for the electrolytic production of zinc, copper, or other metals." M. Perreur-Lloyd. November 26th. (Addition to 4,681/15.) (Complete.)

16,731. "Portable battery lamps." C. A. Vandervell. November 26th.

16,753. "Galvanic batteries." T. H. M. Harvey. November 27th.

16,754. "Apparatus for manufacturing the elements of electric batteries and performing like operations." T. H. M. Harvey. November 27th.

16,765. "System of, and apparatus for, electrically lighting railway and other vehicles." G. D. Peters & Co., Ltd., F. C. Hibberd, and W. King. November 27th.

PUBLISHED SPECIFICATIONS.

1914.

3,583. Contact Breaker for Electro-magnetic Vibrating Members. A. H. Maitre and V. H. G. Martin. February 11th. (February 20th, 1913.)

21,536. Water-tight Electric Bells and the like. J. Bein. October 26th. (March 23rd, 1915.)

22,057. Manufacture of Tungsten Filaments for Electric Incandescent Lamps. F. R. Grote and J. W. H. Reynolds. November 5th.

22,131. Direct-current Dynamo-electric Machines. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 6th.

22,265. Telegraphy. Muirhead & Co. and G. O. Squier. November 9th.

22,383. Dynamo-electric Machines. J. A. Kuyser. November 11th.

22,549. Intercommunication Telephone Systems. C. B. Kersting. November 14th.

22,868. Electrical Relays. H. G. Barwell, W. Judd, and Eastern Telegraph Co. November 21st.

1915.

1,892. Electrically-heated Fluid-pressure Boiler. G. E. A. Holdsworth. February 6th. (Patent of addition not granted.)

2,036. Portable Dry Battery Electric Torches. M. H. Goldstone. February 9th. (May 4th, 1915.)

2,289. Gripping of Electric Cables and the like. W. T. Henley's Telegraph Works Co. and H. Savage. February 12th.

2,349. Method of Establishing a Voltaic Arc between Electrodes not in Contact. F. C. Ucar. February 13th.

3,326. Secondary Electric Batteries or Accumulators. W. S. Naylor. March 2nd.

3,837. Electro-magnetic Switches. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). March 10th.

4,561. Pressure-operated Electric Switches. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). March 23rd.

5,001. Electric Motor Controllers. Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). March 31st.

6,098. Electric Generating Set. A. Collet. April 23rd. (April 30th, 1914.)

9,411. Electrically-operated Bells. E. Kilner. June 28th.

10,130. Electrically-controlled Electric Circuit Breakers. British Westinghouse Electric & Manufacturing Co. July 12th. (July 11th, 1914.)

10,131. Arrangement for supplying Electrical Energy to Direct-current Electric Motors. British Westinghouse Electric & Manufacturing Co. July 12th. (July 11th, 1914.)

10,604. Electrolytic Cells. H. R. Nelson. July 21st. (August 17th, 1914.)